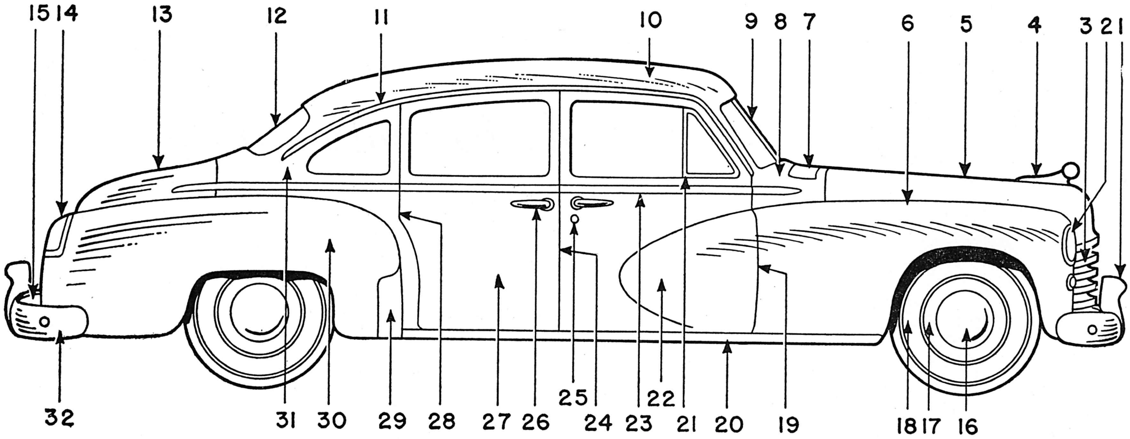
Automobile Body Reconditioning



BODY PANEL SECTIONS AND ACCESSORIES

1. Grille Guard
2. Headlight
3. Radiator Grille
4. Hood Ornament
5. Hood
6. Front Fender
7. Cowl Ventilator
8. Upper Cowl Panel
9. Windshield Center Division Bar
10. Top Panel
11. Drip Molding
12. Rear Window
13. Trunk Lid
14. Taillight
15. Gravel Shield
16. Hub Cap
17. Wheel
18. Tire
19. Front Door Hinge Pillar
20. Rocker Panel Molding
21. Door Window Ventilator
22. Door Cap
23. Belt Molding
24. Center Pillar
25. Door Lock
26. Door Handle
27. Door
28. Rear Door Hinge Pillar
29. Rear Fender Pad
30. Rear Fender
31. Rear-quarter Panel
32. Bumper

Automobile Body Reconditioning

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Preface

The purpose of this book is to serve as a text, reference manual, or handbook, for teachers, persons in training, and mechanics engaged in automobile body reconditioning, and those desiring to improve their knowledge by home study. The automobile body reconditioning trade is a combination of metalsmithing, upholstering, and refinishing. In addition, it calls for many skills which are not found in these trades or any other trade. Much is demanded of the automobile body mechanic. It is the hope of the authors that this book, with its illustrated step-by-step directions for the performance of basic operations, will contribute much to the development of good automobile body mechanics.

The methods used in the selections, arrangement, and presentation of the instructional material are in harmony with the better of the prevailing practices in teaching a trade subject. The units are selected and arranged to provide the repetitive experiences necessary in the development of basic skills. The units are organized and stated so that specific units, operations, steps, or items of information can be referred to without the necessity of reading any considerable amount of supplementary material. Oxyacetylene welding and sheet-metal straightening, both of which are extensively used in automobile body work, are presented in a way that teaches the student these skills correctly, and in the shortest possible time. The devices for teaching the fundamentals of automobile body sheet-metal and welding as pictured and described have proven to be especially helpful.

The procedures herein described are the product of many years of experience in the trade, and years of teaching vocational classes in automobile body work. This book is intended to serve as a supplement to the demonstrations of the teacher and foreman. Also, it should serve the automobile body mechanic on the job as a ready reference on shop kinks. It may well serve as one of the most important tools of the learner in automobile body work.

The authors are also aware of the needs of the home-study group, those persons who do not have the advantage of teacher demonstrations or of the guidance of a foreman. Therefore, the language is simple, the directions easy to follow, and related information is placed where it is needed. The many illustrations supplementing the text are especially helpful to this group.

Sincere appreciation and thanks are extended to Gordon O. Voss, Assistant Professor of Industrial Education, University of Minnesota, Duluth Branch, Duluth, Minn.; to George E. Campaigne, Director of Vocational and Adult Education, Duluth, Minn.; to Bessie Riggle Reinhardt, former Instructor at the University of Minnesota, Duluth Branch, for their encouragement, reading of the manuscript, and helpful criticism and suggestions; to the students in our classes, who contributed by their reactions to the methods and procedures used.

The authors are gratefully indebted to the following companies for their generous supply of pictures and information: Binks Mfg. Co., Chicago; Blackhawk Mfg. Co., Milwaukee; The De Vilbiss Co., Toledo, Ohio; General Exchange Insurance Corp. & Motors Insurance Corp., Detroit; F. J. Hauschild Mfg. Co., Oneonta, New York; The Linde Air Products Co., New York; Minnesota Mining Co., St. Paul; MoToR Book Dept., New York; Peterson Mfg. Co., DeWitt, Nebraska.

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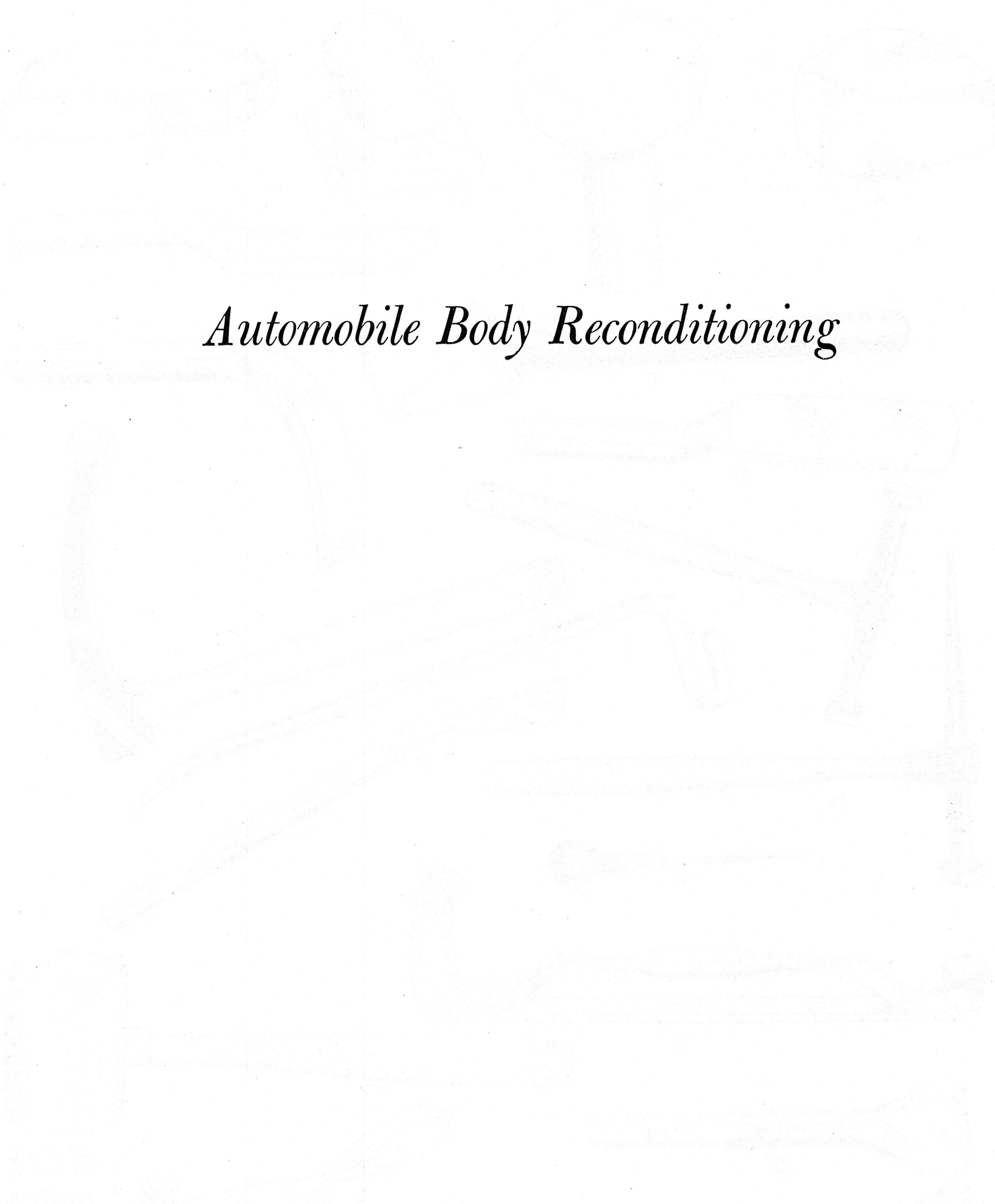


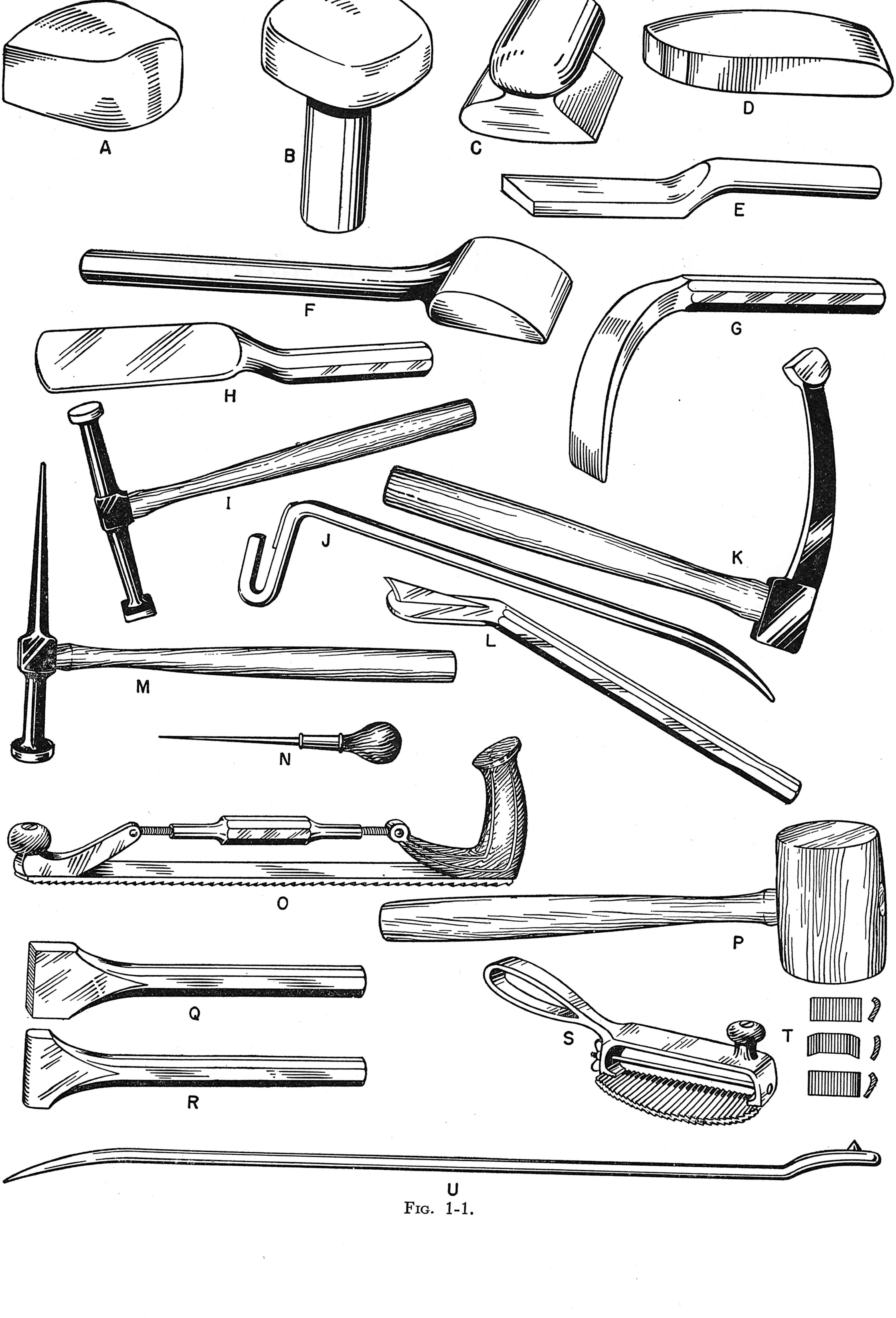


Fig. 1-1.

CHAPTER 1

Basic Hand Tools and Their Application

Present-day body and fender tools have been gradually developed from the tools used by old metalsmiths, who found it necessary in their work to roll, beat, bend, stretch, and shrink metal to form such objects as teakettles, vases, pans, armor, etc. The metalsmith's work was entirely creative when he took a flat or semiround piece of metal and formed it into a finished object. The tools used then were handmade to meet the many specialized needs of the craftsmen.

Today's automotive metalworking tools are directly related to those of the metalsmith. His roughing and dinging hammers are used with variations to suit the thickness of the metal being worked as well as its contour. The old hand anvils used behind the metal have now become various forms of dolly blocks which are hand-held.

From year to year car manufacturers change the contour of body panels. As fast as these changes are made, the body-repairing industry comes up with new special hand tools to meet special configurations that must be handled; therefore it is practically impossible to discuss each specially shaped hammer or other metalworking tool that is to be found.

There is no set number of essential hand tools that a body mechanic should have, since individual needs and circumstances will vary greatly from one mechanic to another. The mechanic will soon realize his own particular needs for special-application tools as he progresses in the trade. A safe rule to follow is to get all tools that will speed up the work and make the job easier.

Figure 1-1 shows the set of tools that is generally known as a "basic set" for general body work. It includes *A,* heel dolly; *B,* bumping dolly; *C,* all-purpose dolly; *D,* flat dolly; *E,* solder paddle; *F,* long-handle dolly; *G,* body spoon; *H,* low-crown spoon; *I,* dinging hammer; *J,* flange tool; *K,* long bumping hammer; *L,* sheet-metal chisel; *M,* pick hammer; *N,* scratch awl; *O,* body file; *P,* rubber mallet; *Q,* flat-face caulking iron; *R,* round-face caulking iron; *S,* reveal file; *T,* blades for reveal file; *U,* long pick.

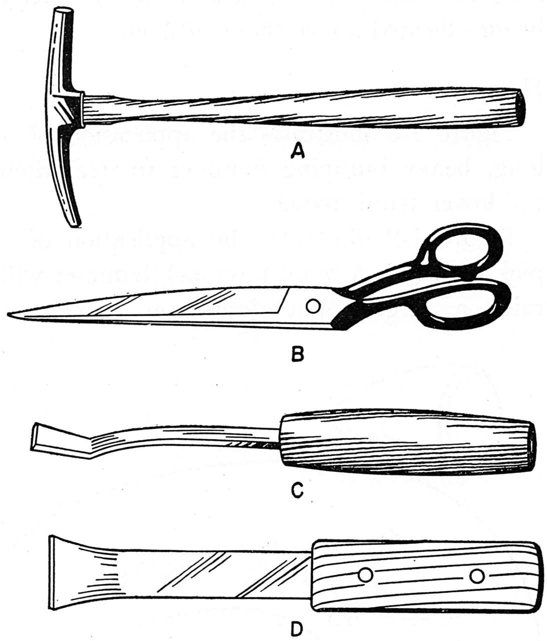


FIG. 1-2.

Figure 1-2 illustrates the upholstery tools necessary for removal and replacement of upholstery: *A,* tack hammer; *B,* shears; *C,* ripping tool; *D,* headlining tool.

Dollies

Figure 1-3 illustrates a bumping dolly used to rough out a fender. The bumping dolly is the heaviest of the dollies, since it is used to back up heavy hammer blows when roughing a bent metal surface into its approximate shape.

Figure 1-4 illustrates a typical application of a heel dolly used extensively for reaching into right-angle corners.

Figure 1-5 illustrates the application of a flat dolly commonly used to form the flange on a new or straightened door panel.

Figure 1-6 illustrates the application of an all-purpose dolly used, in this case, to straighten the trunk panel located below the trunk lid. Because of its combination of curved surfaces, it is the most commonly used.

Figure 1-7 illustrates the application of a long handled dolly to straighten the metal header located above the windshield.

Hammers

Figure 1-8 illustrates the application of a long, heavy bumping hammer to straighten the lower trunk panel.

Figure 1-9 illustrates the application of a pick hammer. A blunt-nose pick hammer will raise a large "spot depression," while a sharply pointed pick will raise a small spot depression. It is often possible to use this hammer to reach over braces. One version of this hammer having a curved pick head is used for reaching into the edges of roof rails, etc. When using a pick hammer on a spot depression, care should be exercised not to raise the depressed surface above the outer panel surface; otherwise a hole may result when filing or rough sanding is performed.

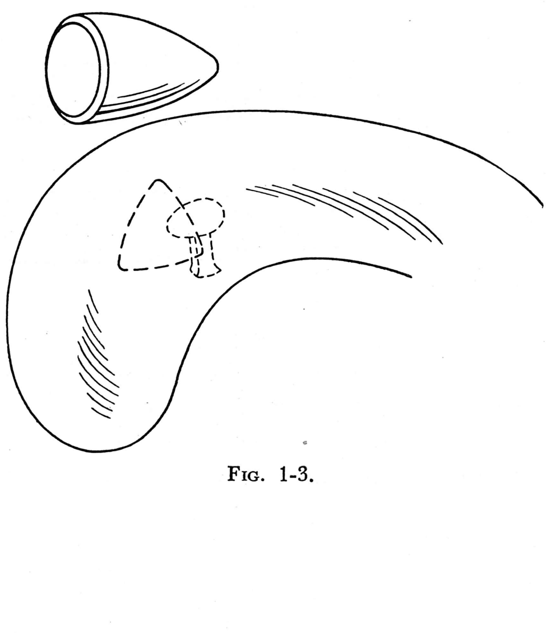
Figure 1-10 illustrates a good application of a rubber mallet when installing a channel on a door glass. To prevent chipping, the lower end of the glass should rest on a rug-protected smooth surface. Rubber mallets are also used to remove "snap bumps" from fenders and door panels. A "snap bump" is a concave depression that, when struck squarely on the opposite side, will cause the metal panel to spring back to its original position, often without a trace of former damage.

Figure 1-11 illustrates the application of a peening (or dinging) hammer used to straighten fender crowns.

Figure 1-12 illustrates a typical tack hammer having one end magnetized to hold upholstery tacks. One end is slightly curved to permit reaching into close quarters, such as the rear shelf, when installing headlining.

Spoons

Figure 1-13 illustrates the application of a low-crown spoon in conjunction with a hammer to drive down a ridge.



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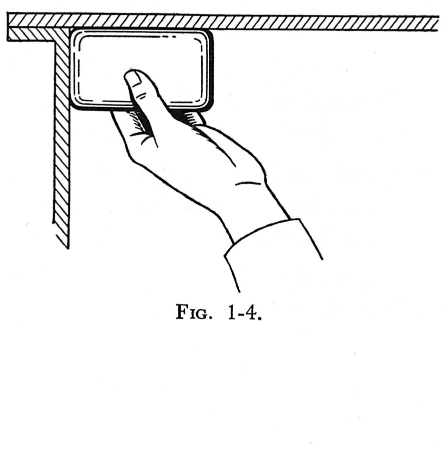

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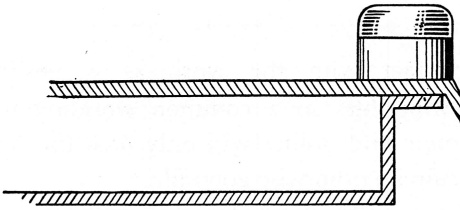
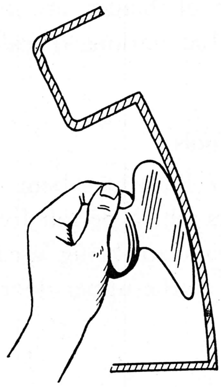


FIG. 1-5.



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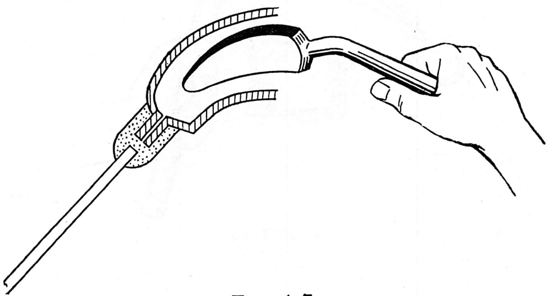

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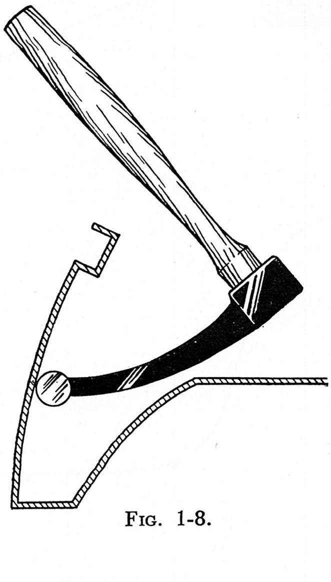

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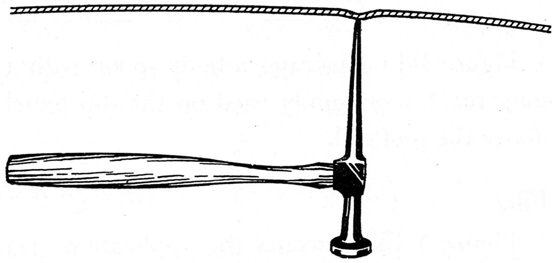


FIG. 1-9.

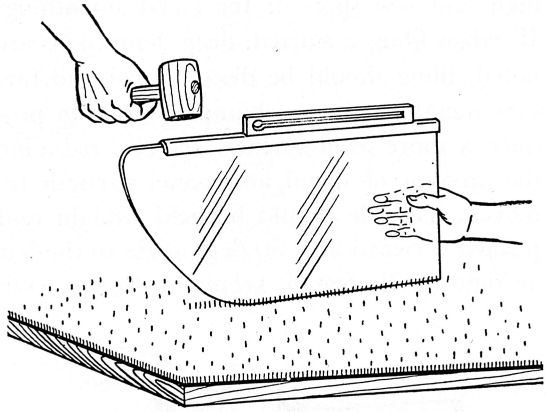
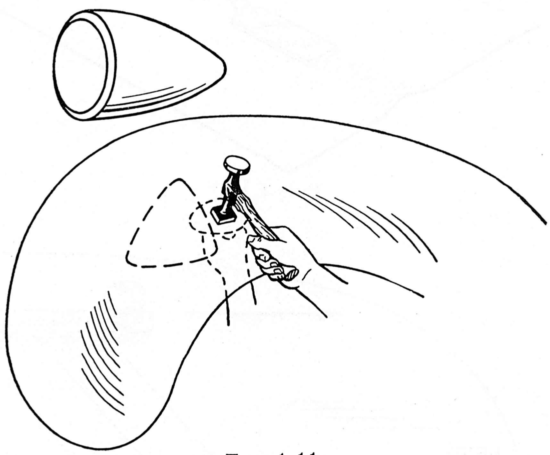


FIG. 1-10.



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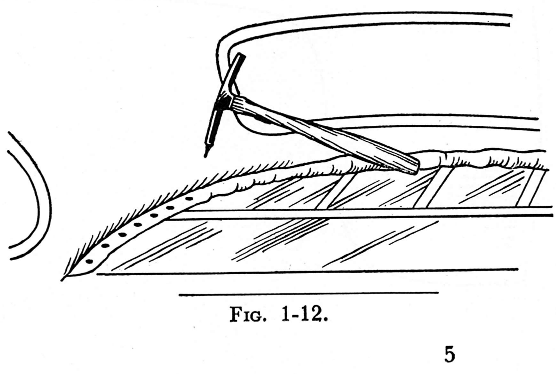


FIG. 1-12.

Figure 1-14 illustrates a body spoon with a long reach, commonly used on the top panel above the roof rail.

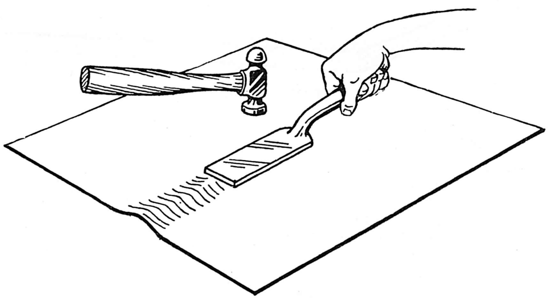
Files

Figure 1-15 illustrates the application of a body file. It can be used either for checking high and low spots or for metal smoothing. If, when filing is started, deep depressions are noted, filing should be discontinued and further metal dinging or bumping done to produce a more level surface, thereby reducing the amount of metal and panel strength removed. The file should be held straight and pushed forward at a 30-deg. angle to the left or right as illustrated, keeping as many teeth in contact with the work as is possible. Throwing files in a common workbox with hammers and dollies will only nick the teeth and ruin an otherwise good file.

Figure 1-16 illustrates the application of the reveal file to smooth window reveals. Several types of blades are furnished with each file so that various reveal contours can be formed.

Upholstery Tools

Figure 1-17 illustrates bent or curved upholstery shears which permit free hand action while the shears are being used across a flat opening such as the upper door opening.



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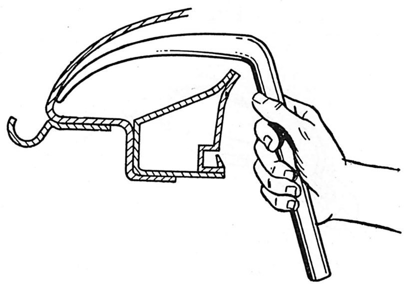

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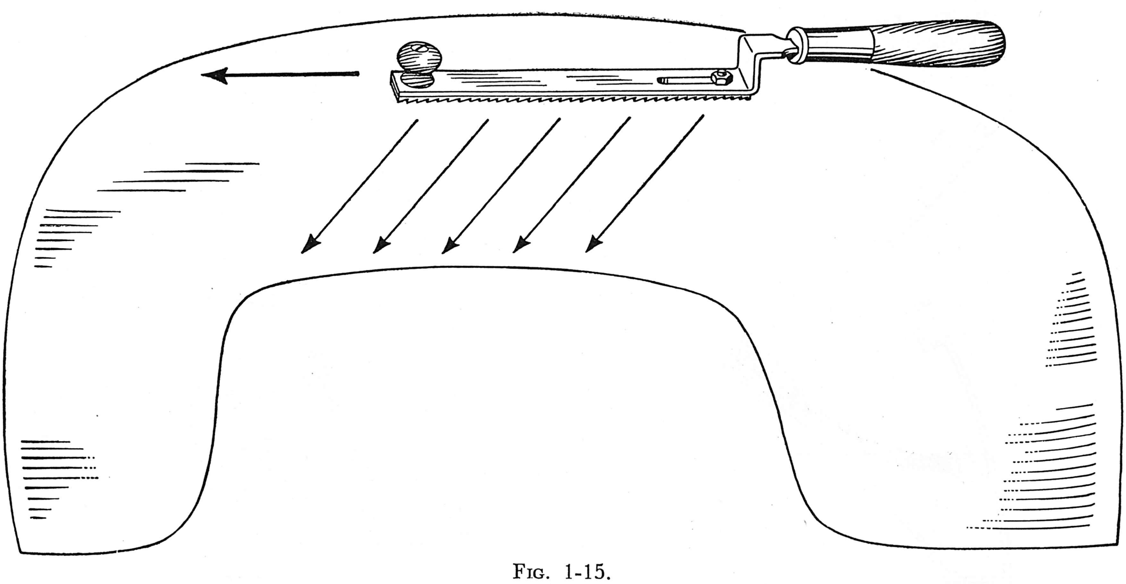


Fig. 1-15.

Figure 1-18 illustrates a ripping or tack-removal tool for pulling tacks from upholstery without tearing it.

Figure 1-19 illustrates the application of a headlining tool for tucking headlining under the edge of the retaining strips.

Miscellaneous Tools

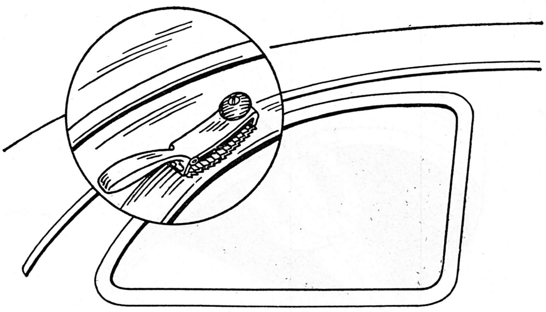
Figure 1-20 illustrates a flange tool used to open or spread flanges.

Figure 1-21 illustrates the application of a sheet-metal chisel. A small hole that is large enough to accommodate the tang of the chisel is drilled first. After placing the tang through the drilled hole, successive hammer blows on the end of the chisel will cause the chisel to cut through the panel.

Figure 1-22 illustrates the application of a caulking iron to straighten a center pillar. It is commonly used to straighten the inside corners of doors, trunk edges, window edges, and wheel openings.

Figure 1-23 illustrates the application of a long pick used to raise small spots on a door panel, where, because of interior bracing, etc., a regular pick hammer cannot be used.

Figure 1-24 illustrates a close-grained wooden paddle to smooth semimolten solder over a damaged area. Wood having the working surface coated with beeswax or mutton



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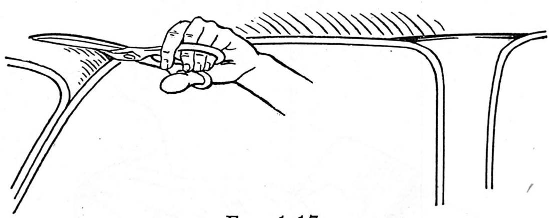

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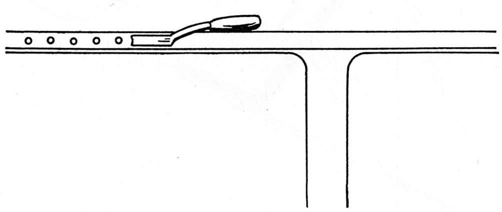

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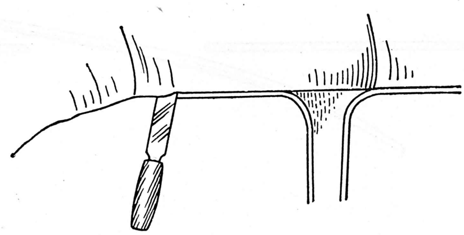

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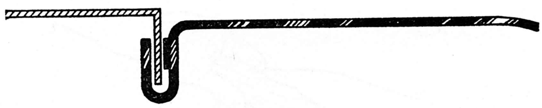

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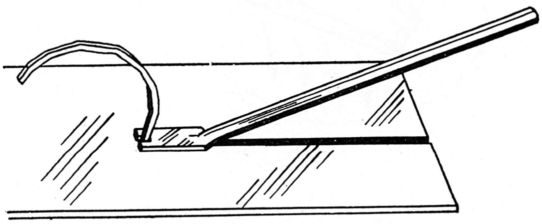

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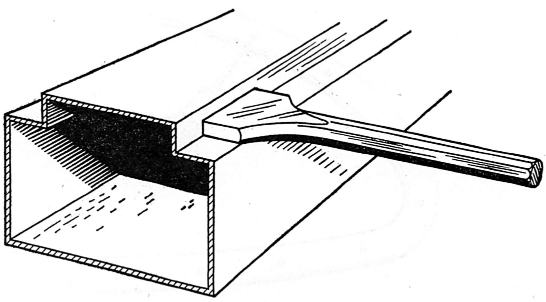
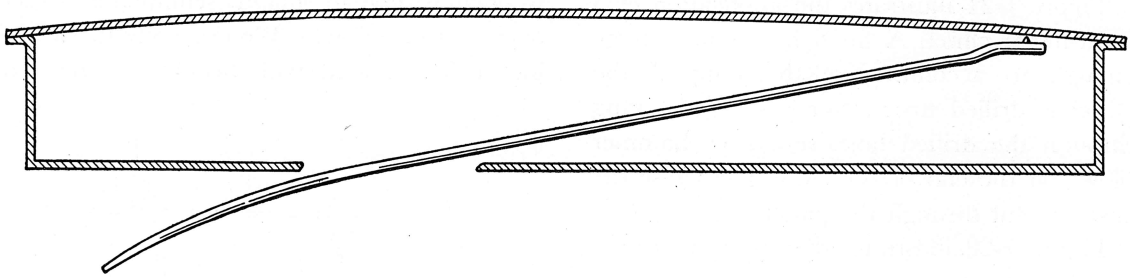


Fig. 1-22.

tallow is used to prevent the working surface from picking up solder. The forward edge of the paddle is slightly raised to prevent the solder from building up on the leading edge. In applying the solder, a sidewise semicircular motion should be made as light hand pressure is applied. Heavy hand pressure forces solder to build around the leading edge of the paddle, thus spoiling the work.

Figure 1-25 illustrates the application of a small scratch awl for locating metal screw holes when installing garnish moldings; the scratch awl is also much used for scribing and marking of metal panels.

Figures 1-26 and 1-27 illustrate typical applications of mechanical gripping wrenches now commonly used more or less as hand vises to hold metal parts for welding, tacking,



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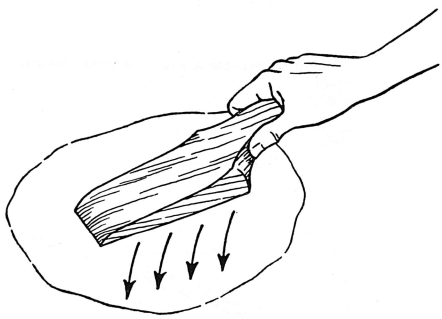
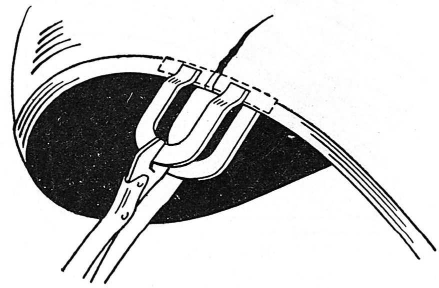


Fig. 1-24.



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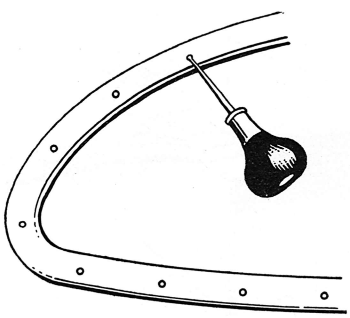

Fig. 1-25.

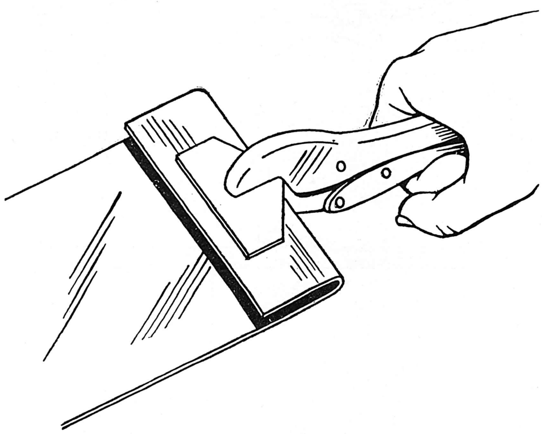

Fig. 1-27.

or aligning operations. The mechanical gripping tools are available with a number of types of clamping heads and greatly facilitate the work on holding operations.

Additional tools should include a set of socket wrenches in ¼-in., ⅜-in., or ½-in. drive; a selection of screw drivers with various length handles and blades as well as those having Phillips-head drives; C clamps; soldering kit including solder paddle, tinning compound, beeswax or mutton tallow, clean rags, and spatula.

Most of the above equipment is normally considered as general mechanics' tools; additional equipment, such as electric drills, etc., is considered as shop equipment.

Questions

1. What are the 20-odd tools in the basic set for the body mechanic?
2. How are snap bumps removed?
3. Which tool is used for checking high or low spots?
4. What tool has its working surface covered with beeswax or mutton tallow? Why?
5. At what angle should a body file be held in relation to the work?

CHAPTER 2

Welding Equipment and Methods of Application

Welding Equipment and Operation

Welding equipment is used not only for welding, but also for forging welds, shrinking, soldering, cutting, and heating metal for bending.

Figure 2-1 shows the welding regulators, hoses, torch body, tips of various sizes, goggles, and lighter.

Figure 2-2 shows the complete outfit with tanks and truck.

The pressure in the tank is too high for welding, and a regulator is used to cut down the pressure. On the regulator are gauges showing tank pressure and pressure to the torch. The adjusting is done by means of a hand screw on the regulator. Thus, the amount of oxygen and acetylene fed to the torch are controlled. More oxygen is picked up from the air around the tip of the torch while the torch is lighted.

Usually, it is better to have the welding outfit portable than stationary, thus eliminating the need for long hoses. With a portable welding outfit, the danger of running over the hoses is less, and the operator can watch the pressure on the gauges. Also, it is easier to bring the welding outfit to the job than the job to the welding outfit.

There is a routine procedure for setting up welding equipment, a procedure devised to ensure the safety of the operator and to prevent damage to the equipment.

A bibliography of books on welding is provided at the end of this chapter for those who wish to further acquaint themselves with the many operations to which both gas welding and electric welding lend themselves.

Procedure 1—Setting up Equipment

1. Set the tanks of oxygen and acetylene on the welding truck, and fasten them securely to the truck with a chain or strap iron.

NOTE: Be sure to leave the cap on the oxygen tank until the tanks are securely fastened to the truck, to ensure against damage to the valve and possible accident.

2. Remove the cap from the oxygen tank.
3. Crack the valves on both tanks to blow out any dirt that may have collected in the valve port.

a. "Cracking the valve" means to open it slightly and close it quickly.

CAUTION: Make sure there are no sparks or open flame nearby when cracking the acetylene valve. Do not breathe acetylene gas.

b. Always stand to one side when cracking valves.

4. Connect the regulators to the tanks.

a. Oxygen connections have right-hand threads; acetylene connections have left-hand threads.

CAUTION: Never wipe fittings with the bare hand. Oil is always present on the skin. Oxygen and oil or grease under pressure might explode.

5. Release the hand screws on the regulators.

a. The high pressure from the tanks will damage the regulators if the tank valves are opened when the regulator-adjusting screws are turned in.

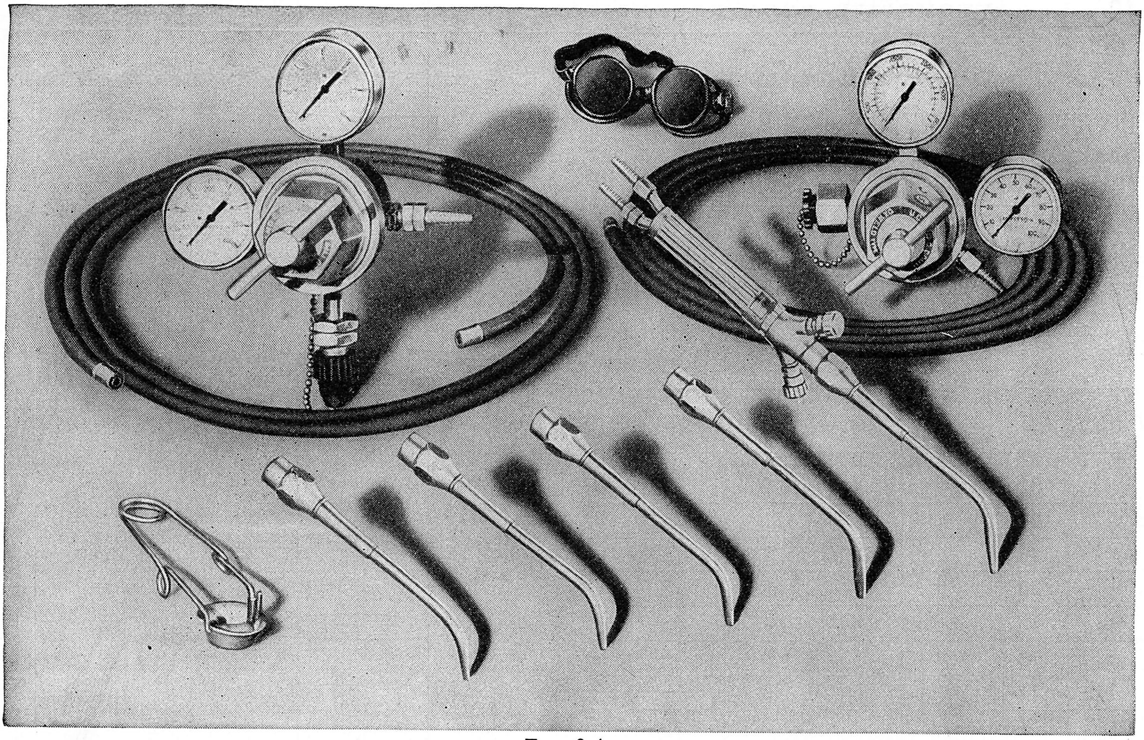

FIG. 2-1.

6. Connect the hoses to the regulators.

a. Green or black hoses are for oxygen. Red hoses are for acetylene.

7. Open the tank valves *slowly*.

a. The acetylene valve should be opened one full turn, and the oxygen valve should be opened as far as it will go.

b. An acetylene tank is equipped with a packing nut. An oxygen tank is equipped with a double-seated valve, making it necessary to open it as far as it will go to prevent the oxygen from escaping around the stem of the valve.

CAUTION: Do not stand directly in front of the regulators while opening tank valves.

8. Turn the regulator-adjusting screws in, to blow the air from the hoses; then release them.

9. Connect hoses to the torch body.

Procedure 2—Lighting a Torch

1. Insert a tip in the torch body.

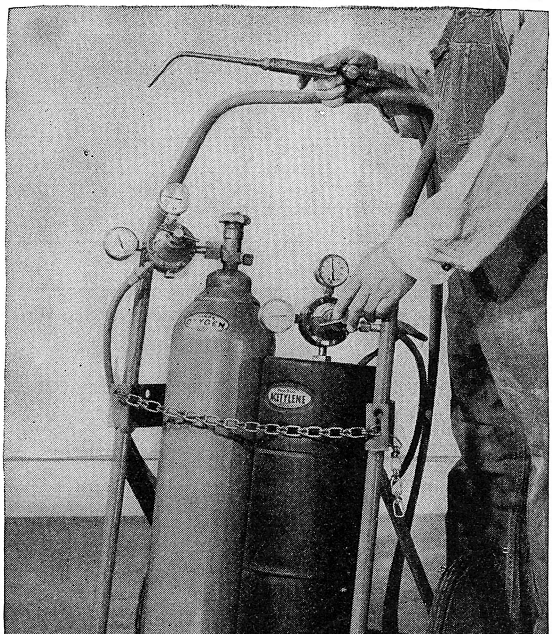

FIG. 2-2.

2. Adjust the regulator to the correct pressure for the size of the tip in the torch. See chart of Welding Pressures:

Metal this thick (in.)	Metal this thick (ga.)	Use welding head size on blowpipe W-109	W-110	W-111	With these pressures* (lb. per sq. in.) for both oxygen and acetylene
	32	1	1	1	5–7
	28	1	1	1	5–7
	25	2	2	2	5–7
1/32	22	2	3	3	5–7
1/16	16	3, 4	4	4	5–7
3/32	13	4	5	5	5–7
1/8	11	4, 5	6	6	5–7
3/16		5, 6			5–7
			7	7	5–8
1/4		6	8	8	6–9
		7			5–8
3/8		7	9	9	7–10
		8			6–9
1/2				10	8–11
5/8				11	9–12
3/4				12	9–12
1 and over				13	10–13

* Regulator setting with 25-ft. hose lengths. *Welding and Cutting Manual*, Linde Air Company.

3. Open the acetylene valve on the torch, slightly.

4. Light the torch with a flint lighter.

5. Open the acetylene valve on the torch until the flame merely begins leaving the end of the tip.

6. Open the oxygen valve on the torch until the torch is adjusted to a neutral flame.

Figure 2-3 shows the acetylene flame merely leaving the tip.

Figure 2-4 shows a flame with too much acetylene.

Figure 2-5 shows a neutral flame.

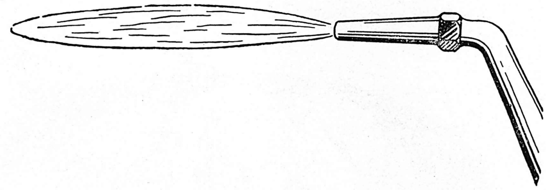

Fig. 2-3.

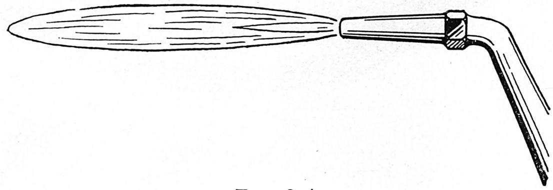

Fig. 2-4.

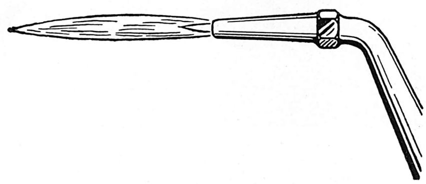

Fig. 2-5.

Procedure 3—Shutting Off Torch

1. Close the acetylene valve on the torch.
2. Close the oxygen valve on the torch.

a. Acetylene is shut off first, because it is the gas that burns. The oxygen supports the burning, making a hotter flame.

3. Close the valve on the acetylene tank.
4. Close the valve on the oxygen tank.
5. Open both valves on the torch to release the pressure from the regulators.

NOTE: Do not leave pressure on the regulators when they are not in use.

6. Release the pressure on the regulators by turning the adjusting screws out until they are free.
7. Close the torch valves.
8. Hang the hoses and torch around the truck handles to keep them from becoming damaged.

Procedure 4—Cutting Attachment: Lighting and adjusting

1. Remove the welding tip from the torch body, and connect the cutting attachment and tip.

a. Make sure that all valves on the torch and on the cutting attachment are closed.

2. Open the valve on the acetylene tank and on the oxygen tank.

a. Make sure that the regulator adjusting screws are fully released.

3. Adjust regulators to proper pressures.

a. For 20-gauge sheet metal, the acetylene pressure should be 5 lb. and the oxygen pressure 20 lb.

4. Open the acetylene valve on the torch ⅛ turn, and then light the torch.

5. Adjust the valve until the flame barely leaves the tip of the torch.

6. Open wide the oxygen valve on the torch body.

7. Open the oxygen valve on the cutting attachment, and adjust it until the preheating flames are neutral.

a. Cutting tips have a center hole surrounded by four or more smaller holes. The small holes provide oxygen-acetylene flames, to preheat the metal to start cutting and to keep the cut going after it has started. The center hole provides the oxygen that does the cutting.

8. Press down the oxygen lever to check the adjustment of the preheating flames.

a. Further adjustments may have to be made to maintain well-defined cones of flame when the oxygen jet is turned on.

9. To shut off the torch, reverse the lighting procedure.

Safety and General Information

After the welding outfit has been set up, check all connections with soapy water.

CAUTION: Never use an open flame to check for leaks.

Lubricate threads with beeswax.

CAUTION: Keep welding equipment free from oil and grease.

Hoses lying on the floor should be protected from damage such as might be caused by flying sparks from welding, moving of equipment, etc.

Never lay the torch on the floor. It may be run over or stepped on and the valves thereby bent.

Use tip cleaners. Do not try to clean the welding tip by rubbing it on the table or floor.

Do not use faulty equipment. Repair or replace it.

Use only approved lighters.

Mark all empty tanks.

Store tanks in a safe place.

Never use pliers on any connections. Use a wrench.

Do not bleed tanks. "Bleeding" is the attempt to get oxygen or acetylene from an empty tank by turning the hand screw on the regulator. This damages the regulator.

CAUTION: 1. Be extremely careful always to know where the torch is pointing.

2. Always keep a fire extinguisher handy when welding.

3. When welding or cutting, always wear goggles to prevent injury to the eyes.

Welding Sheet Metal

A body mechanic must be a good sheet-metal welder. Sheet-metal welding is somewhat different from plate welding. Heat travels fast in sheet metal, and the resulting warp must be controlled. It is easier to control warp on high-crown surfaces than on low-crown surfaces.

In body work, flat welds are desirable,

especially on fenders and outer panels, because welds with a high bead require too much time to dress down. The weld can be made with the build-up on the underside, as in the following operations.

Beginners are usually troubled by their welds getting wider and wider as the weld progresses. To control the heat, the torch is raised and lowered to keep the weld of uniform width and penetration. Changing the angle of the tip in relation to the metal being welded is another way of controlling the heat.

Be sure to follow all safety rules when welding. Never become careless with a welding torch, thereby endangering yourself and others. Take all safety precautions against fire when welding near inflammable materials. Keep fire extinguisher handy at all times. *Always wear welding goggles when welding.*

Tools and Equipment

Welding outfit; No. 1 welding tip; tin snips; Vise-Grip wrench; dinging hammer; bench vise; ¼-in. electric drill; 3⁄16-in. twist drill; disk sander; safety goggles; No. 36 closed-coat disk; steel rule.

Materials

20-gauge cold-rolled sheet metal; 1⁄16-in. mild-steel welding rods; 1⁄16-in. bronze welding rod; brazing flux.

Procedure 1—Welding without Rod

The object of this procedure is to acquaint the learner with the fundamentals of sheet-metal welding and to teach him manipulative skills in using a welding torch to control the heat and the flow of the metal. A good weld cannot be made without the proper control of the puddle. A continuous puddle must be maintained as the weld progresses, by raising and lowering the torch or by changing the angle of the tip to the work.

1. Cut a piece of sheet metal 3 by 8 in.

2. Light the torch and adjust it to a neutral flame, using a No. 1 tip.

3. Beginning at one end, run a weld across the sheet metal without using the welding rod (Fig. 2-6).

a. The cone of the flame should be 1⁄16 in. from the metal. Never touch the cone of the flame to the sheet metal.

b. Point the flame in the same direction as that in which the weld is being made (Fig. 2-7).

c. Check the torch from time to time for neutral setting.

d. Raise and lower the torch to control the width of the weld and for uniform penetration.

4. Turn the piece over and examine the weld for uniform penetration.

a. Proper penetration has been achieved when the metal is fused through the lower surface.

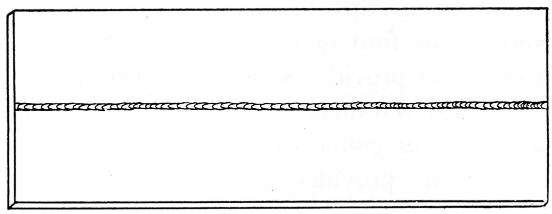

Fig. 2-6.

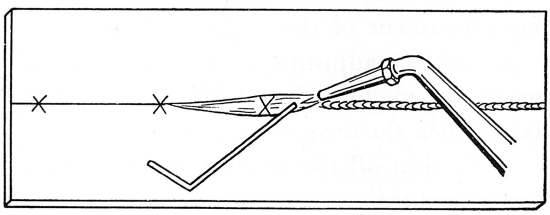

Fig. 2-7.

Procedure 2—Welding with Rod

The learner can now begin using a welding rod to run a bead on a piece of sheet metal. When the rod and metal in the puddle

are liquid, they will flow together and a bead will be formed as metal from the rod is melted into the puddle. The welding rod is held away from the puddle for a distance of the thickness of the rod. When the rod is held too far away, a drop of metal will form on the end of the rod and oxidize before it drops into the puddle, thus making a poor weld. The rod should not be pulled away from the metal when it sticks. Melt it loose with the torch.

1. Cut a piece of sheet metal 3 by 8 in.

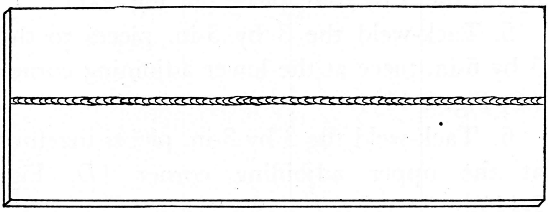

FIG. 2-8.

2. Light the torch and adjust to a neutral flame, using a No. 1 tip.

3. Run a weld across the sheet metal, using a 1/16-in. mild-steel welding rod (Fig. 2-8).

4. Turn the piece over and examine the weld for uniform penetration.

a. The weld should be flat on the upper side, and most of the bead should be on the underside.

Procedure 3—Welding Two Pieces Together with Rod

Whenever heat is applied to metal, expansion causes warp. To help prevent this and also to hold the edges of two pieces in position during the welding operation, tack welds are used. Tack welds should be as small as possible so that they may be opened if necessary for further alignment of body panels, patches, etc.

1. Cut two pieces of sheet metal 1½ by 8 in.

2. Place the pieces side by side with the 8-in. edges touching, and tack-weld them together, using a 1/16-in. welding rod.

a. Tack-weld the ends first, then the center. Continue tack-welding, making each new tack weld at the mid-point between two welds already made, alternating from side to side until the welds are about 1 in. apart (*A,* Fig. 2-9).

3. Weld the seam solid with a 1/16-in. welding rod (B, Fig. 2-9).

4. Turn the piece over and check it for penetration.

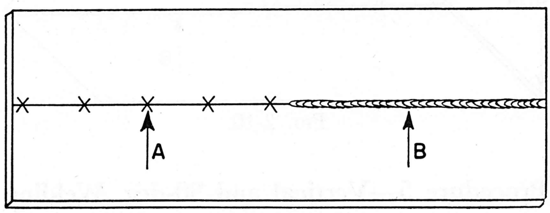

FIG. 2-9.

Procedure 4—Welding Pieces Together without Rod

Two pieces of sheet metal can be welded together without using a welding rod, and this makes a neater weld than is made when a rod is used. Enough metal is present when the edge of one piece overlaps the other the thickness of the metal to take the place of the rod. The procedure is the same as Procedure 1, so far as the puddle is concerned.

1. Cut the pieces of sheet metal 3 by 8 in.

2. Set up the pieces at an angle of 90 deg., making one overlap the other the thickness of the sheet metal.

3. Light the torch and adjust it to a neutral flame, using a No. 1 tip.

4. Tack-weld the pieces together without using a rod.

a. Tack-weld from one end to the other, spacing the welds ¾-in. apart. Keep the pieces lined up during welding (*A,* Fig. 2-10).

5. Run a continuous weld along the entire edge without using a rod (*B,* Fig. 2-10).

a. Metal from the overlapping piece will supply enough material to make a good fusion weld.

b. Control the heat by raising and lowering the torch to make a uniform weld.

6. Turn the piece over and check the penetration.

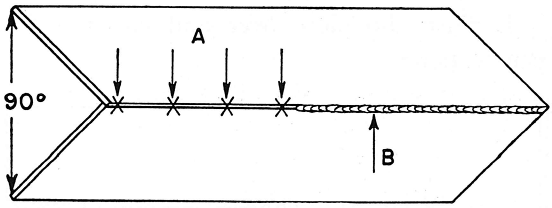

FIG. 2-10.

Procedure 5—Vertical and 90-deg. Welding

The vertical and 90-deg. types of welds often occur in body work. Careful tack welding is necessary to keep the pieces in alignment until the weld is completed. Proper heat control must be used to make an even weld on both pieces. Difficulty may be encountered if the rod sticks to either piece and causes the weld to become too wide.

1. Cut a piece of sheet metal 5 by 6 in.

2. Make a 90-deg. flange ¾ in. wide along both 6-in. edges of the piece (*A,* Fig. 2-11).

a. Place the piece in a vise to make the flanges.

3. Cut two pieces of sheet metal 3 by 3 in.

4. Join the 3 by 3-in pieces at an angle of 90 deg., one edge overlapping the other for the thickness of the metal, and set them up on the 5 by 6-in. piece (*B,* Fig. 2-11).

5. Tack-weld the 3 by 3-in. pieces to the 5 by 6-in. piece at the lower adjoining corner (*C,* Fig. 2-11).

6. Tack-weld the 3 by 3-in. pieces together at the upper adjoining corner (*D,* Fig. 2-11).

7. Tack-weld the remaining two corners of the 3 by 3-in. pieces to the 5 by 6-in. piece (*E,* Fig. 2-11).

8. Tack-weld and then weld solid the 3 by 3-in. pieces as in step 5, Procedure 4, from bottom to top (*C,* to *D,* Fig. 2-11).

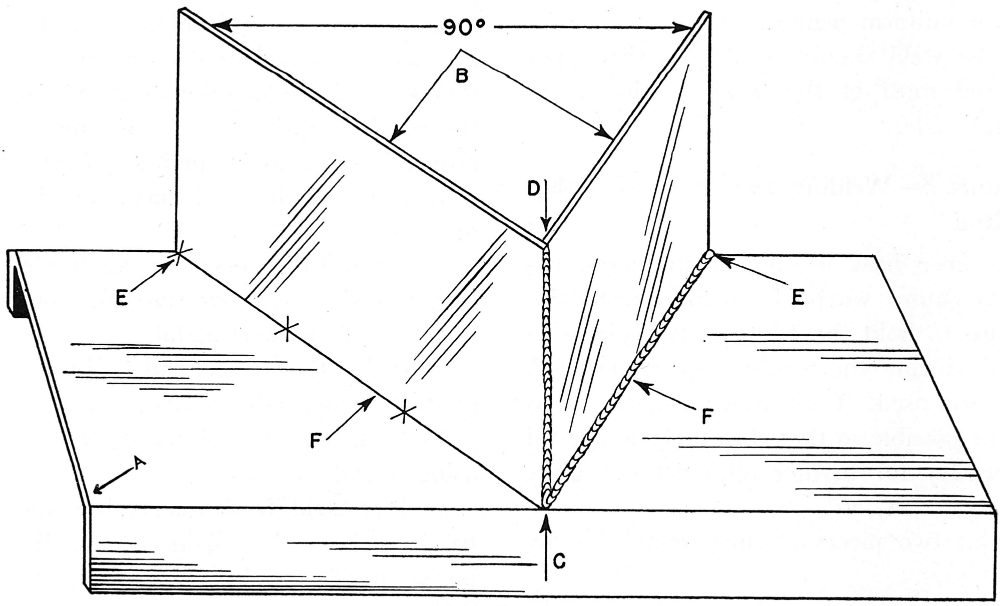

FIG. 2-11.

9. Tack-weld and then weld, using a rod, the 3 by 3-in. pieces to the 5 by 6-in. piece, along the lower edges (*F*, Fig. 2-11).

Procedure 6—Spot Welding

Spot welding with a torch is different from electric spot welding. Factory spot welding is done electrically. Spot welds made with a torch resemble factory welds and have proved to be good substitutes for electric spot welds. A beginner should master this procedure because it helps to prevent warp, makes a neater job, and often eliminates soldering.

1. Cut two pieces of sheet metal 3 by 8 in.
2. Drill 3/16-in. holes, 1/4 in. from the edge, 1 in. apart, along the 8-in. side of one piece.
3. Overlap the edges 1/2-in. with the holes on top (*A*, Fig. 2-12).

a. Use a Vise-Grip wrench to hold the pieces together.

4. Light the torch and adjust it to a neutral flame.
5. Heat a bronze rod and dip it in brazing flux.
6. Heat to a dull cherry red the bottom piece of the sheet metal through the hole at one end of the top piece, and weld with the bronze rod (*B*, Fig. 2-12).

a. The bronze should fill the hole level with the top surface.

b. Using too much bronze will only be waste.

7. Weld the first hole at the other end in the same way (*C*, Fig. 2-12).
8. Weld the center hole next (*D*, Fig. 2-12) and then the remaining holes by alternating from side to side.
9. Grind the spots flush with the upper piece, using a No. 36 closed-coat disk.

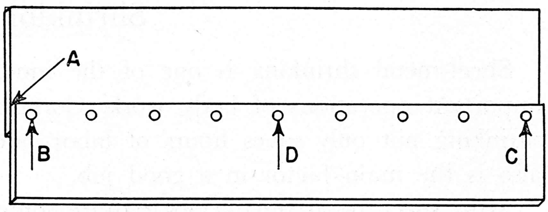

Fig. 2-12.

Forging a Weld

Because of a change that has taken place in the metal when welding, sheet metal will often break next to a weld. This can be overcome by *forging* a weld.

Forging is done by heating a weld and flattening it to the thickness of the surrounding metal. When a weld is forged, the heat is distributed over a larger area, leaving the weld approximately the same thickness as the rest of the metal; and the structure of the metal is not materially changed. It then causes no obstruction to an air hammer, soldering becomes almost unnecessary, time is saved, and a better, neater job results.

Forging is also a good test of a weld. A weld that does not break during forging is, for all practical purposes, as strong as the rest of the metal.

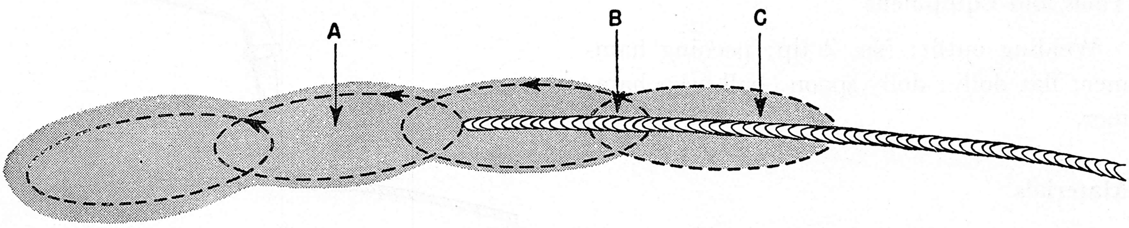

Fig. 2-13.

Tools and Equipment

Welding outfit; No. 3 tip; dinging hammer; all-purpose dolly; disk sander; safety goggles.

Materials

A 3 by 8-in. piece of sheet metal with a weld; No. 36 closed-coat disk.

Procedure

1. Light the torch and adjust it to a neutral flame.

2. Heat a part of the weld to a cherry red.

a. The size of the heated spot should be about 1½ in. long and a little wider than the bead of the weld.

3. Using an all-purpose dolly for backing up blows which are now applied to the heated spot, flatten the bead of weld.

a. Do not attempt to flatten the bead when the spot has cooled; reheat the spot and repeat the flattening process (Fig. 2-13).

b. Forged area is shown at *A*, Fig. 2-13.

c. Each successive heated spot must extend into the preceding flattened area (*B*, Fig. 2-13).

4. Continue heating and flattening spots of the same size until the whole weld is flattened (*C*, Fig. 2-13).

5. Smooth the weld with a No. 36 closed-coat disk.

Shrinking Sheet Metal

Sheet-metal shrinking is one of the most important operations of body work. Correct shrinking not only saves hours of labor but also is the main factor in a good job.

Most sheet-metal repair jobs require some shrinking, and improper shrinking can make the damage almost impossible to repair.

It is rather difficult to determine the correct amount of shrinking, since the metal is expanded when hot and will be stable only when cooled; therefore, metal should be overshrunk and brought back to proper contour by stretching.

Only by adhering rigidly to proper procedure in shrinking can a good job be done in the shortest length of time.

Tools and Equipment

Welding outfit; No. 2 tip; peening hammer; flat dolly; dolly spoon; ball-peen hammer.

Materials

20-gauge cold-rolled sheet metal.

Procedure 1—To Shrink a Small, Round Spot

1. Light the torch and adjust it to a neutral flame.

2. Heat to a cherry red the spot to be shrunk.

a. Keep the cone of the flame ½ in. from the surface of the metal (Fig. 2-14).

b. Be careful not to overheat or burn a hole in the metal.

3. Strike two quick open blows (without dolly) on the heated spot.

a. Open blows must be struck while the spot is cherry red.

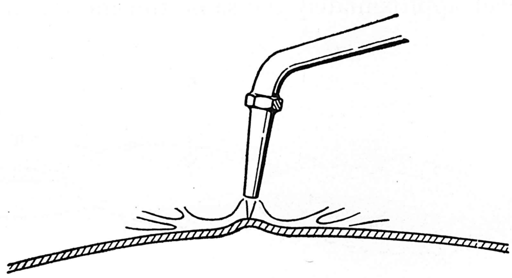

Fig. 2-14.

4. Back the heated spot with a flat dolly, and flatten the metal with a peening hammer.

NOTE: Speed is the important factor in shrinking.

Procedure 2—To Shrink an Oblong Area

1. Study the stretched metal to determine the area to be shrunk (Fig. 2-15).

2. At a point ½ in. from the end of the area to be shrunk (*B*, Fig. 2-15), and equidistant from the two sides, heat to a cherry red an oblong spot 1½ by ½ in. (Fig. 2-16).

a. Heat as rapidly as possible to prevent the heat from expanding a large area.

3. Strike two quick open blows on the heated spot.

4. Back the heated spot with a flat dolly, and flatten the metal with a peening hammer.

a. Keep the metal in proper contour at all times while shrinking.

5. Shrink successive spots (*B* to *C*, Fig. 2-15), extending each spot into the preceding spot.

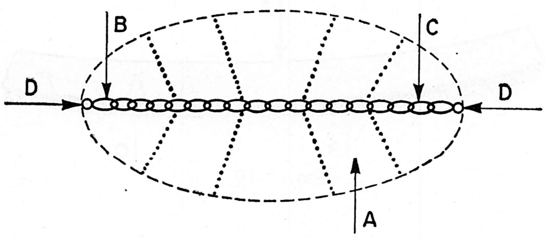

FIG. 2-15.

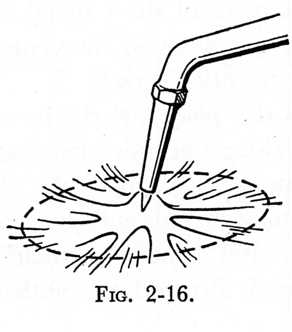

FIG. 2-16.

a. The reason for heating oblong spots is to draw the metal from the sides and not from the ends (see dotted arrows in Fig. 2-15).

6. Heat a small, round spot about the size of a dime at each end of the shrunken area (*D*, Fig. 2-15), and flatten as in operations 3 and 4.

a. This is done to prevent the strain from extending beyond the shrunken area.

b. If any part of the metal collapses during the shrinking process, use a dolly and a peening hammer to stretch the spot last shrunk until the metal returns to the original contour.

Procedure 3—To Shrink a Long, Stretched Crease

1. Beginning at one end, heat to a cherry red a spot 3 in. long in the bottom of the crease (*A*, Fig. 2-17).

2. While the spot is cherry red, use a body spoon and a ball-peen hammer to raise the metal above the surface of the panel.

3. Repeat operations 1 and 2 the entire length of the crease (*A* to *B*, Fig. 2-17).

a. The metal in the damaged area must be raised to make shrinking possible.

4. Shrink as in Procedure 2.

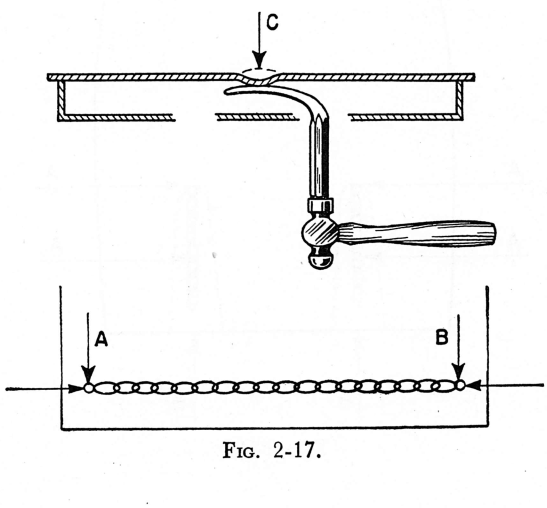

FIG. 2-17.

Procedure 4—To Shrink the Cowl Edge of a Hood

1. At ½ in. from the edge of the metal, heat to a cherry red a spot 1½ in. long and ½ in. wide.

a. Avoid heating the edge of the metal.

2. Strike two quick open blows on the heated spot.

3. Back up the heated spot with a flat dolly, and flatten the metal with a peening hammer.

4. Proceed shrinking to the end of the stretched area, working away from the edge at points *A,* Fig. 2-18.

a. The shrunken area strains the metal, causing the edge to buckle and making it possible to shrink.

5. Heat the edge to a cherry red and shrink at points *B,* Fig. 2-18.

6. Heat small spots at points *A*, Fig. 2-18. and shrink.

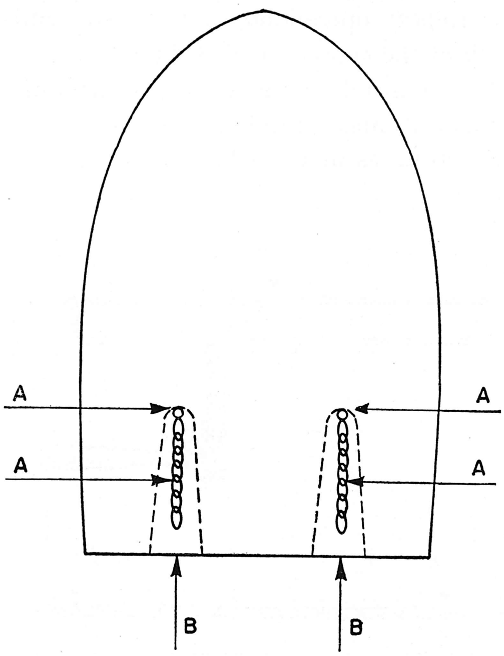

Fig. 2-18.

Procedure 5—Straightening and Shaping Angular Sheet Metal

1. Cut a piece of sheet metal 2 by 16 in.

2. Brake the piece in the center to a 90-deg. angle its entire length.

3. Curve the piece by placing it in a vise (Fig. 2-19).

a. Bend the piece gradually to curve it. Only one side of the angle will stretch.

b. The stretched area will be along edge *B,* Fig. 2-19.

4. Heat spots to a cherry red at 2-in. intervals along the stretched side of the sheet metal (*C,* Fig. 2-19).

a. When a spot is heated, the piece can be straightened at that point by placing it in a vise and bending it.

5. Heat and bend the piece straight, one spot at a time, along the entire stretched area.

a. Notice the wrinkles along the edge after the piece has been straightened.

6. Shrink the wrinkles.

a. The same procedure can be used on U channels, *e.g.*, a trunk gutter.

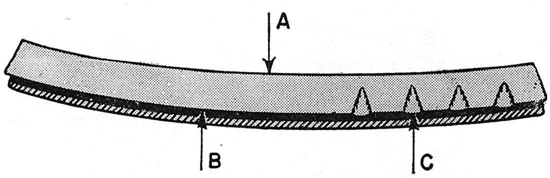

Fig. 2-19.

Procedure 6—To Curve a Sheet-metal Angle

1. Cut a piece of sheet metal 2 by 16 in.

2. Brake the piece in the center to a 90-deg. angle its entire length.

3. Place the piece loosely in a vise, and heat spots along one side; bend at the same time into an arc 5 in. in height (Fig. 2-20).

a. Beginning at one end, heat a spot to a cherry red, and bend the angle while the spot is heated. Proceed to another spot 1½

in. from the first spot, and bend as before. Continue heating and bending to the center of the angle. Perform the same operation from the other end.

b. Wrinkles are formed as shown in *A,* Fig. 2-20.

4. Shrink the wrinkles along the edge *B,* Fig. 2-20.

a. Notice *C,* Fig. 2-20, has not stretched during the shaping but has only curved.

b. If the piece has been curved too much, simply stretch the side that has been shrunk with a hammer and dolly until the curve is correct.

c. By holding the angle in a vise opened 3 in. and using one jaw of the vise as a dolly, the correct curvature can be maintained during the shrinking process.

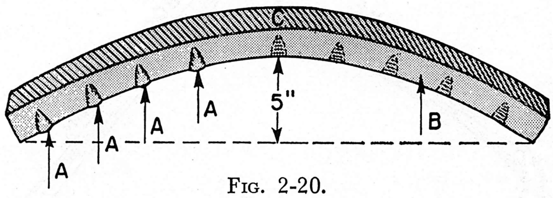

Fig. 2-20.

Applying Body Solder

Body solder is used to fill small dents and to restore contours in places that cannot be reached for straightening. Filling dents with solder saves time but is permissible only if the result is satisfactory. A dent that requires a large amount of solder should be straightened because excess solder will crack from vibration. Solder should never be used in place of sheet-metal straightening, nor should it be allowed to cover poor and unfinished work.

Body solder is 30 per cent tin and 70 per cent lead. It takes low heat and is smoothed with a solder paddle coated with beeswax or mutton tallow. It takes practice and a high degree of skill to do good soldering.

Tools and Equipment

Welding outfit; No. 3 tip; disk sander; safety goggles; wire brush; soldering kit; body file.

Materials

Body solder; No. 36 open-coat disk tinning flux.

Procedure

1. Remove all rust, slag, and paint from the surface to be soldered.

a. Use a disk sander or a wire brush for cleaning.

2. Tin the spot to be soldered at least 1 in. beyond the damage. Tinning can now be best performed by using one of the newer flux agents containing both tin and chemicals which clean the area to be tinned. If small amounts of paint or undercoating material remain, the flux is strong enough to eat through the foreign material and produce a bright tinned surface.

a. Adjust the flame as in Fig. 2-21, using carburizing flame, and hold it about 3 in. from the surface.

b. Heat the metal to a point at which the tinning compound will adhere to the metal.

c. While the metal is hot, apply the tinning compound with a spatula and wipe clean with a rag. If some spots that were not tinned remain, heat the spots, clean with a wire brush, and retin.

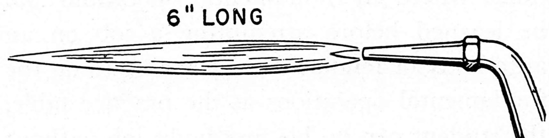

Fig. 2-21.

3. Holding the torch in one hand and the solder in the other, heat metal and solder at the same time, keeping most of the heat on the solder (Fig. 2-22).

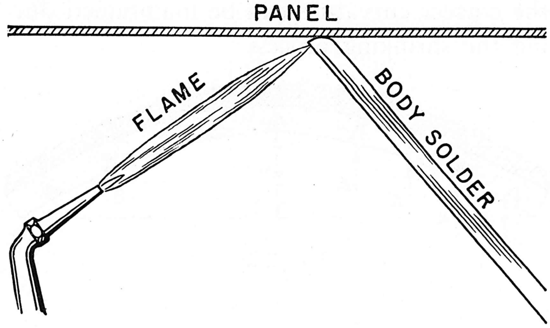

FIG. 2-22.

a. Check the heat by touching solder to metal. When the solder adheres to the metal, it is hot enough to begin application. Too much heat will make the solder run.

b. With most of the heat on the solder bar, play the flame over the soldered area to keep the solder plastic for smoothing.

4. Apply the solder until it is a little above the surface of the metal, to allow for smoothing.

5. When sufficient solder has been put on a spot, smooth with a paddle, using the motion shown in Fig. 2-23.

a. Never allow solder to cool during application and smoothing process, because cooling and reheating cause granulation.

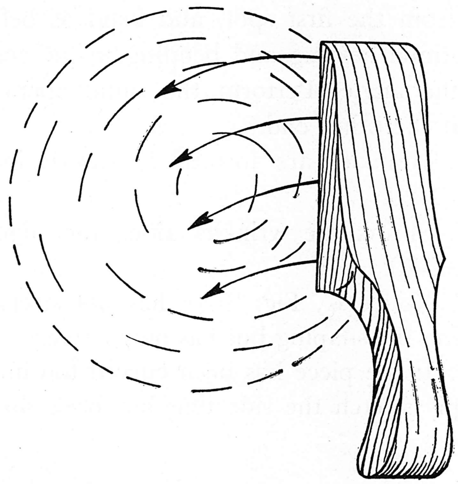

FIG. 2-23.

6. Smooth the solder roughly with a No. 36 open-coat disk.

7. File the solder, with position and direction as in Fig. 2-24.

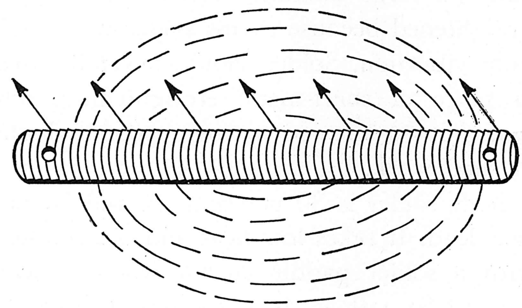

FIG. 2-24.

Use of the Sheet-metal Practice Table

The sheet-metal practice table (Fig. 2-25) is the invention of one of the authors of this book and was designed to meet the needs that arose in his classes. A sheet of metal can be firmly bolted to the practice table, where all fundamental operations can be learned before attempting a job on an auto body or fender. After learning to do the fundamental operations at the practice table, the student can do his first body job without doing more damage than repair.

Before the use of a practice table was available, a beginning student had to practice on the auto body or fender, and his efforts usually created more damage than they corrected.

This chapter includes the following operations: shrinking, stretching, welding, forging, straightening, filing, tinning, soldering, preparing the surface for painting, sanding, masking, mixing paints, spraying, compounding, and striping.

Tools and Equipment

Sheet-metal practice table; welding outfit; No. 2 welding tip; dinging hammer; pick hammer; all-purpose dolly; flat dolly; body file; tin snips; aviation snips; ¼-in. electric drill; ¼-in. twist drill; paint spray gun; sanding block; sponge; putty squeegee; striping brush; steel square; scratch awl; soldering kit; ball-peen hammer; cold chisel.

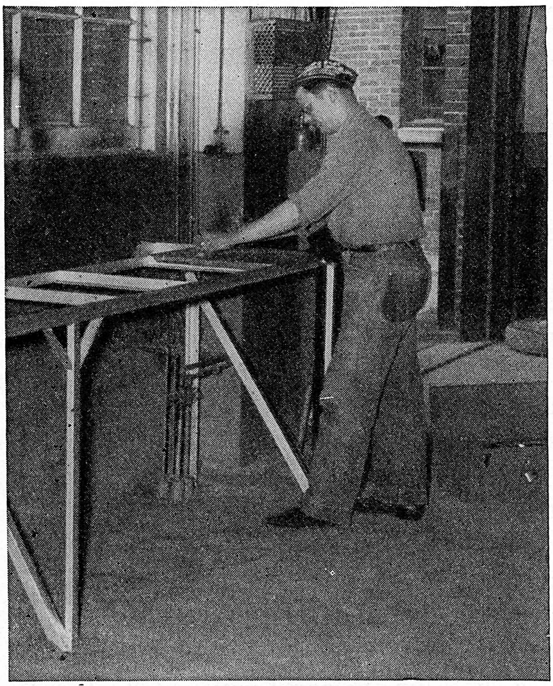

FIG. 2-25.

Materials

One piece of 20-gauge cold-rolled sheet metal, 19½ by 19½ in.; one piece of 20-gauge cold-rolled sheet metal, 6½ by 6½ in.; ¹⁄₁₆-in. mild-steel welding rod; ⁵⁄₃₂-in. mild-steel welding rod; one sheet No. 80 sandpaper; one sheet each of No. 320 and No. 400 sandpaper; rust remover; primer-surfacer; glazing putty; lacquer paint; enamel thinner; red- and green-enamel striping paint; masking tape and paper; medium rubbing compound; eight ¼ by ¾-in. cap screws and nuts; body solder; rags.

Procedure

1. With a scratch awl, scribe lines ¾ in. from the edge around the 19½-in. square of sheet metal (*A*, Fig. 2-26).

2. Cut off the corners at lines *B*, Fig. 2-26.

3. Brake the edges to make flanges, as in cross section, Fig. 2-27.

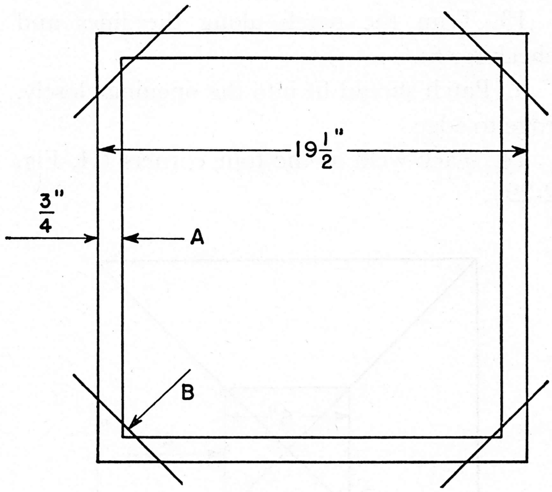

FIG. 2-26.

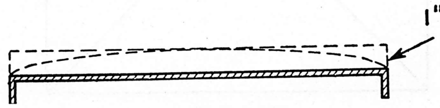

FIG. 2-27.

4. Place the panel on the practice table, mark holes, drill, and mount on the table with ¼ by ¾-in. cap screws and nuts.

5. Make a few dents in the panel with the peening end of a ball-peen hammer, striking blows from the underside.

6. Shrink the metal where dents were made (see the section on Shrinking Sheet Metal, p. 18).

7. Crown the panel 1 in. by stretching (Fig. 2-27).

8. Locate the center of the panel, and

scribe off a 6 by 6-in. square in the center of the panel (*A,* Fig. 2-28).

9. Cut a hole in the center of the panel with a cold chisel, cutting from the underside.

10. Cut out the 6 by 6-in. square from the center of the panel with aviation snips.

11. Cut a patch of sheet metal 6½ by 6½ in.

12. Place the patch piece under the panel, and scribe from on top with a scratch awl.

13. Trim the patch along the lines and check for fit.

a. Patch should fit into the opening closely, edge to edge.

14. Tack-weld at the four corners (*A,* Fig. 2-29).

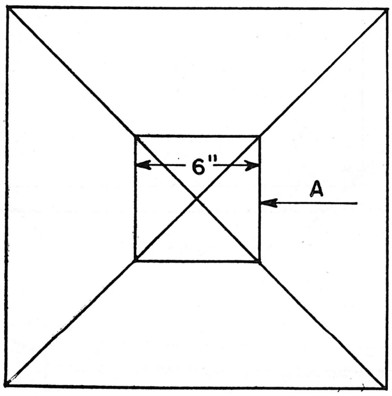

Fig. 2-28.

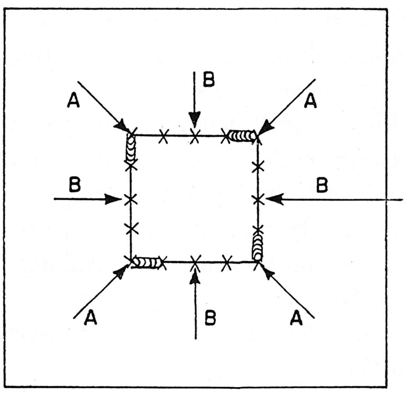

Fig. 2-29.

15. Tack-weld at centers between corners (*B,* Fig. 2-29).

16. Tack-weld at mid-points between welds around the patch, alternating from side to side.

a. Tack welds should be 1 in. apart.

17. Weld 2 in. of the seam, then 2 in. on the opposite side of the patch, then 2 in. on the third and fourth sides, respectively, and repeat until the weld is solid.

NOTE: Keep correct contour of the panel during the welding operation.

18. Forge the weld around the patch (see section on Forging a Weld, p. 17).

19. Smooth the panel by picking and filing.

20. Tin a 1-in.-wide strip around the outer edge of the panel (*A,* Fig. 2-30).

21. Solder a strip ½ in wide around the outer edge of the panel (*B,* Fig. 2-30). See also section on Applying Body Solder, p. 21).

22. Smooth the solder with a body file, making it flat with the rest of the panel surface.

a. Always file from the outer edge toward the center of the panel.

23. Make a small dent in the center of the panel by striking an open blow from the top with the peen end of a ball-peen hammer (*C,* Fig. 2-30).

a. Back up the panel with a dolly, but do not strike on the dolly.

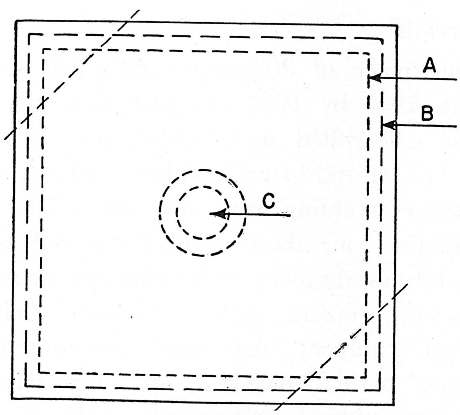

Fig. 2-30.

24. Solder the dent (see section on Soldering Small Dents in Panels, p. 26).

25. Smooth the solder with a body file.

26. Remove the panel from the table.

27. Weld a 5/32-in welding rod to the back side of the panel diagonally across two opposite corners, placing them not less than 3 in. from the corners (see dotted lines in Fig. 2-30).

a. This reinforcement is necessary to keep the panel rigid.

b. Be careful not to melt the solder from the panel during welding.

28. Sand the panel by hand with No. 80 sandpaper, and round off the panel edges.

a. Paint will not adhere to sharp edges.

29. Clean the panel with rust remover, and wipe dry with a clean rag.

30. Prime the panel with one coat of primer-surfacer (see chapter on Painting Equipment and Technique, p. 110, for painting operations).

31. Apply a thin coat of putty over the entire panel, spreading the putty in one direction (*A*, Fig. 2-31).

32. Sand the putty, using a sanding block and No. 80 sandpaper.

33. Spray three coats of primer-surfacer over the entire panel.

a. Allow 15 min. for drying between coats and 30 min. before sanding.

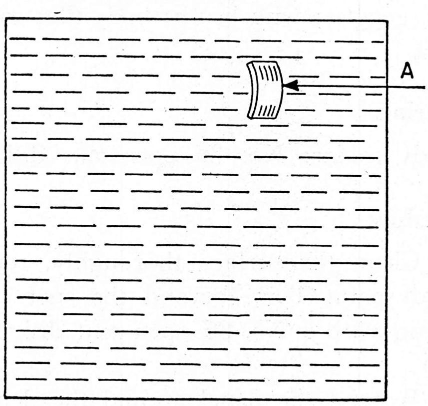

FIG. 2-31.

34. Sand with No. 320 sandpaper, using a sanding block and water.

a. Use plenty of water to keep the paper clean.

b. Panel must be perfectly smooth and free from pinholes and scratches.

35. Spray one-half of the panel with four coats of white lacquer paint (*A*, Fig. 2-32).

36. Sand the white area with No. 400 sandpaper and water.

37. Mask off the white area, from the center to two corners, to form a triangle (*B*, Fig. 2-32).

38. Clean the unpainted area with enamel thinner, and spray with four coats of red lacquer paint (*A*, Fig. 2-33).

a. Allow 15 min. for drying between coats and 30 min. before sanding.

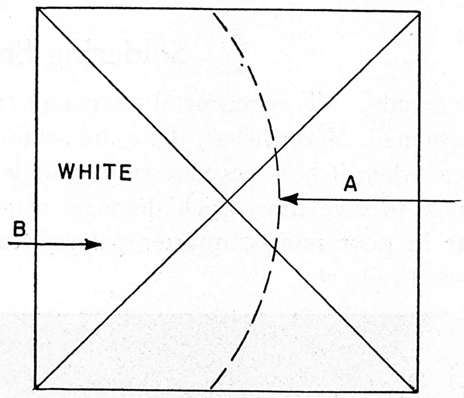

FIG. 2-32.

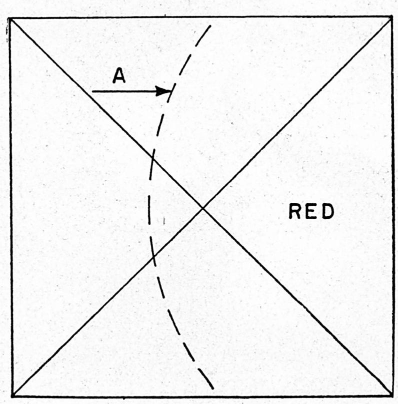

FIG. 2-33.

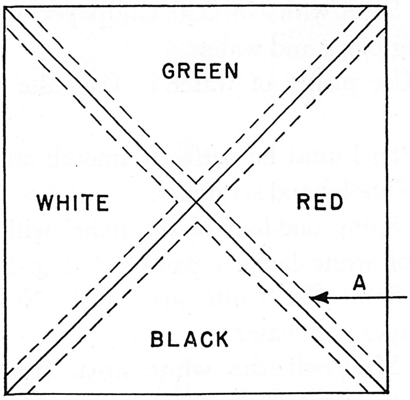

FIG. 2-34.

39. Wet-sand the red area with No. 400 sandpaper.

40. Mask off the red triangle the same as the white triangle.

41. Spray one of the remaining triangles with green lacquer paint.

42. Wet-sand the green area with No. 400 sandpaper.

43. Mask off the green triangle.

44. Spray the remaining triangle with black lacquer paint.

45. Wet-sand with No. 400 sandpaper.

46. Remove the masking, and hand-rub the panel with rubbing compound.

a. Use medium rubbing compound.

47. With red-enamel striping paint make $\frac{1}{16}$-in. stripes $\frac{3}{8}$ in. from the edge of the white, the green, and the black triangles (*A*, Fig. 2-34).

48. Stripe the red triangle with green-enamel striping paint.

The panel is now finished and may be hung up for display in the classroom.

Soldering Small Dents in Panels

Generally, all sheet-metal damages are straightened. Nevertheless, there are some instances when it becomes necessary to solder a damage to save time. Such damages usually occur in door panels, quarter panels, trunk lids, roof rails, etc.

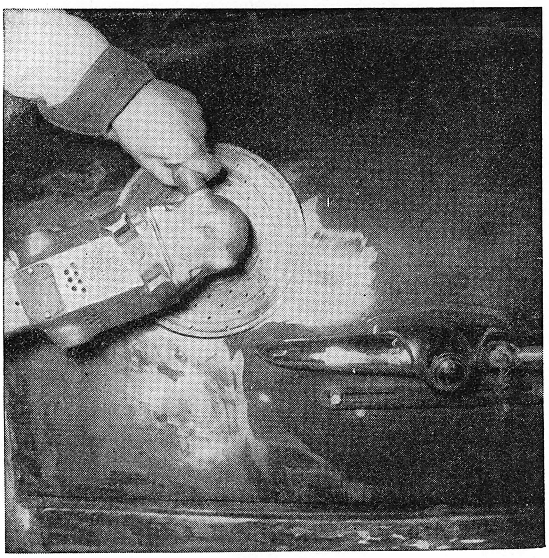

FIG. 2-35.

Time means money in a shop, and any good short cut is valuable. However, a short cut is good only when a good job results.

This is one way to solder a small dent in a panel without removing upholstery, to accomplish the primary objective of saving time.

Tools and Equipment

Welding outfit; No. 2 tip; disk sander; safety goggles; wire brush; body file; soldering kit.

Materials

Body solder; No. 36 open-coat disk.

Procedure

1. Clean the surface thoroughly, removing all paint 1 in. beyond the spot to be soldered with a No. 36 open-coat disk (Fig. 2-35).

2. Expand the panel around the dent by starting about 6 to 8 in. from the dent. Heat-

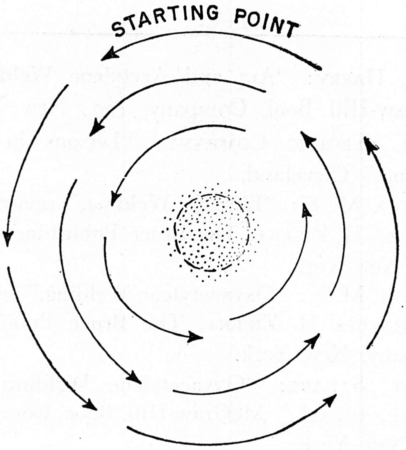

FIG. 2-36.

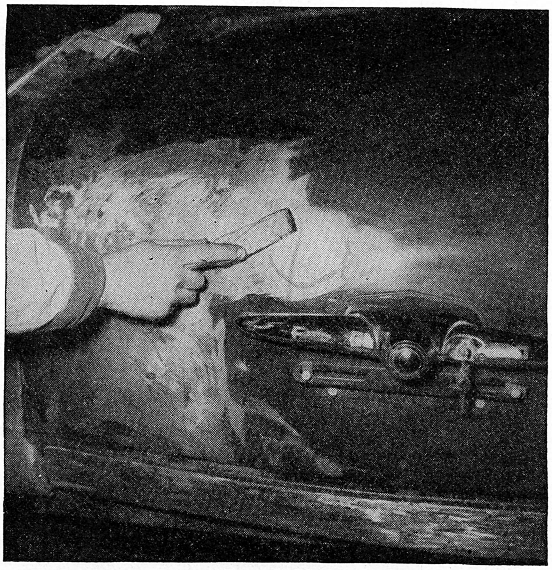

FIG. 2-38.

ing and expanding the panel prevents collapsing. Gradually work toward the center of panel (Fig. 2-36).

a. Heat the panel only for expansion, being careful not to scorch the paint.

3. When the panel around the dent is expanded, quickly tin the damage (Fig. 2-37. See also section on Applying Body Solder, p. 21).

4. Apply body solder (Fig. 2-38).

a. Be sure the entire panel is expanded during tinning and soldering operation.

b. Should the panel collapse, allow it to cool completely, and repeat the operation,

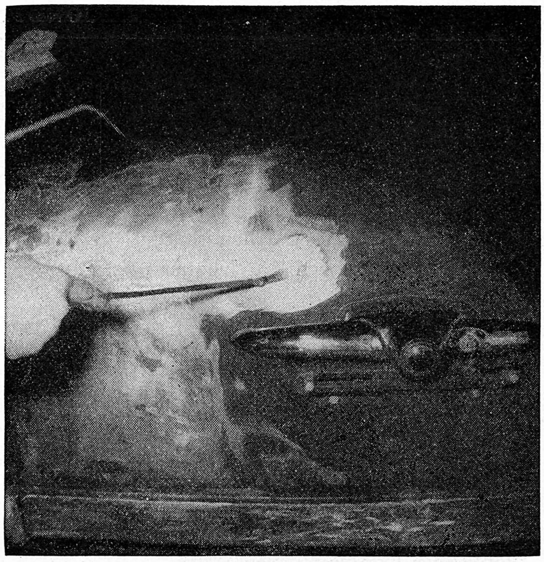

FIG. 2-37.

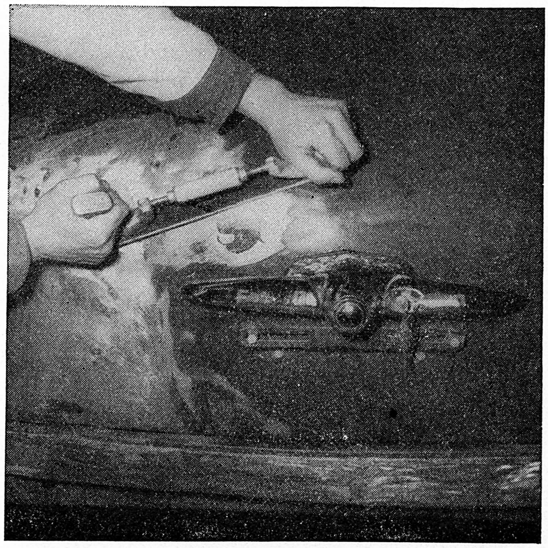

FIG. 2-39.

following instructions more carefully.

5. Smooth the solder roughly with a No. 36 open-coat disk.

6. Smooth the soldered area with a body file (Fig. 2-39).

QUESTIONS

1. What is the function of a regulator?
2. Should fittings be wiped with bare hands?
3. Why are grease and oil hazardous around gas welding equipment?
4. What are the types of flames?
5. What are the advantages of a spot weld?

6. Why are some welds forged?
7. Why should sheet metal be overshrunk slightly?
8. How hot should sheet metal be when tinning, and how is it checked?
9. Why is the sheet-metal practice table used?
10. What paper is used when sanding (*a*) putty, (*b*) primer-surfaces, (*c*) lacquer paint?

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CHAPTER 3

Basic Metal-straightening Techniques

Using a Disk Sander

Figure 3-1 shows the correct direction in which a disk sander should be moved. As much surface of the disk as possible should touch the metal. The dotted line across the backing plate shows the portion of the disk to be in contact with the metal when sanding. Begin at the top and move in the direction indicated by the arrows (Fig. 3-1). Moving the sander from the front to the rear along the high crown of a fender will cut a crease, because the disk is contacting only a very small portion of the metal. The more surface the disk contacts, the smoother and truer the surface will be. Skillful sanding will make filing necessary only for checking.

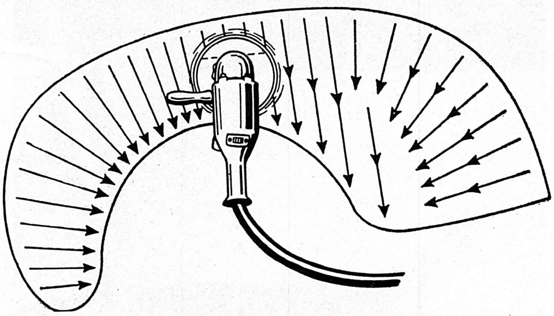

FIG. 3-1.

A surface is not necessarily straightened because it is sanded and bright. It may be smooth but wavy.

Use a No. 36 open-coat disk for removing old paint and for sanding rusted areas. Use the same number disk on solder. This type of disk is called *open* because the grit particles are not close together, thereby allowing the disk to throw off the sanded particles and remain clean.

Use a No. 36 closed-coat disk for sanding metal, and finish with a No. 50 closed-coat disk.

NOTE: Do not use a coarser disk than necessary. It makes extra work when smoothing.

Use only light pressure on the sander. The speed of the sander, not the pressure, is the main factor in fast cutting.

CAUTION: Wear safety goggles when sanding.

Always hold the sander securely. Be cautious when working around corners and sharp edges. The disk can catch on such places and be violently torn from the backing plate, injuring the operator.

Never place a sander on the floor while it is running. When the sander is plugged in and not in use, be sure to lay it in a safe place. The possibility that someone will step on the switch and cause injury either to himself or to the operator is ever-present.

Always ground electrical equipment. A shorted sander and a wet floor are a dangerous combination. A three-prong plug and outlet for ground wire is the safest hookup.

Protect electric cords from possible injury.

Never lift the sander by the cord. This can cause a short in the sander.

Using a Sheet-metal Brake

A sheet-metal brake (Fig. 3-2) is a useful piece of equipment in a body shop. It can be

used for many jobs, such as making panels, fender braces, channels, etc.

Using Stands

Figure 3-3 shows adjustable stands. Always place stands under the car before removing wheels. The operator has no assurance of safety when using a jack while working under a car. The jack may be accidently released.

Using a Hydraulic Jack

Figure 3-4 shows a hydraulic jack. Never overload a jack. A 3-ton jack is not made to lift 10 tons. Use the correct size jack for the job.

Always be sure that the saddle is properly positioned before raising a load. Gas tanks, crankcases, brake lines, etc., can be damaged when a car slips off a poorly positioned jack saddle.

Frequent greasing and checking of the fluid level prolong the life of a jack.

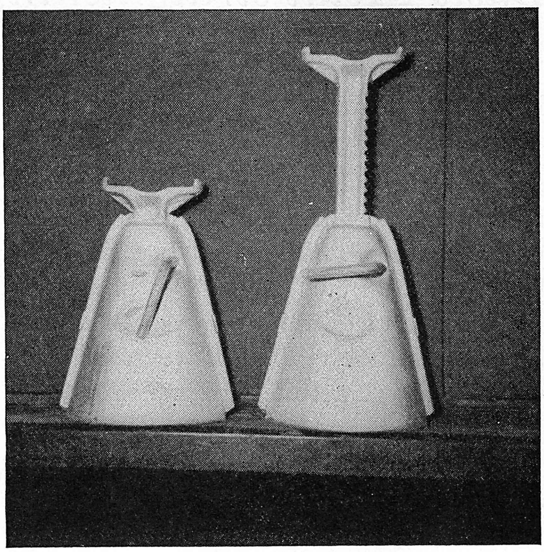

FIG. 3-3.

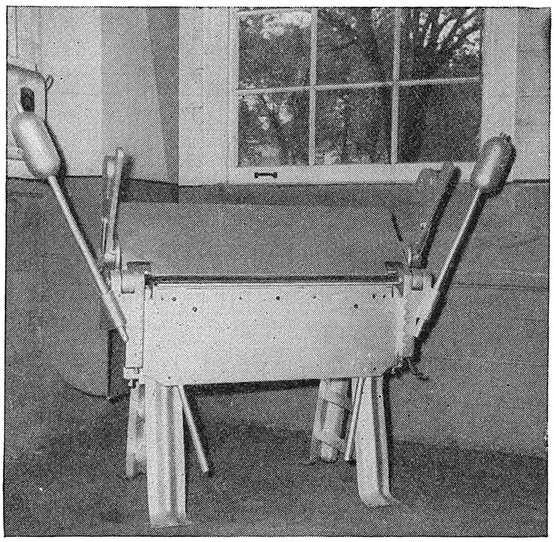

FIG. 3-2.

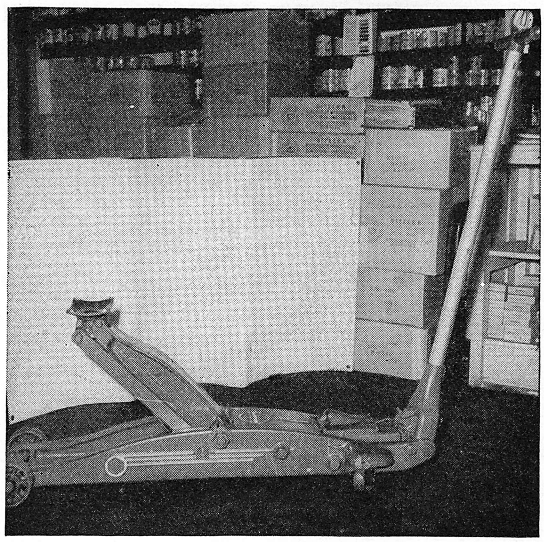

FIG. 3-4.

Cutting Sheet Metal

Cutting sheet metal correctly saves time and promotes neater work. Straight, clean edges are necessary; therefore the proper use of snips is important.

Two types of snips are in common use in a body shop: the regular tin snips and the aviation snips. Tin snips are used for straight cuts. Aviation snips are used for irregular

cuts and places hard to reach. There are right- and left-hand aviation snips.

Cutting 20-gauge sheet metal with a cutting torch requires a different technique than cutting heavier gauge sheet metal. Sheet metal heats up so rapidly that the cut easily becomes ragged.

The following exercises should be repeated until proficiency is attained.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; tin snips; aviation snips; steel square; divider; Vise-Grip wrench; center punch; ball-peen hammer; cold chisel; scratch awl; chalk.

Materials

20-gauge sheet metal.

Procedure 1—Cutting with Snips

1. Cut a piece of sheet metal 3 by 8 in. with tin snips.

a. Hold the snips at right angles to the surface of the metal.

b. The snips should be opened wide and closed ¾ the length of the jaws, then moved forward, and another cut made in the same way.

c. If the snips are closed all the way to the points when cutting sheet metal, they will leave a jagged edge (Fig. 3-5).

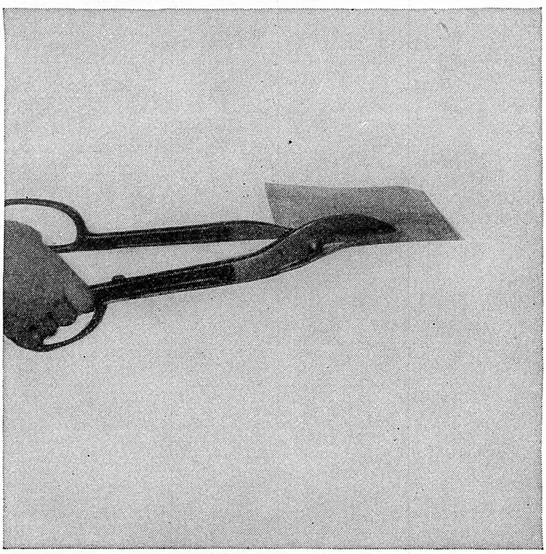

Fig. 3-5.

2. Scribe a 2 by 2-in. square on one end of the 3 by 8-in. piece.

3. Cut out the square with aviation snips (*A*, Fig. 3-6).

a. Aviation snips are so constructed that the angle of the snips in relation to the metal being cut will vary according to the cut being made.

b. Keep corners sharp and square.

4. Center punch and, using the divider, scribe a circle 2 in. in diameter on the other end of the 3 by 8-in. piece of sheet metal (*B*, Fig. 3-6).

5. To get an opening for the snips, punch a hole in the center of the circle with a cold chisel (*C*, Fig. 3-6).

6. Cut out the circle with aviation snips (Fig. 3-7).

Procedure 2—Cutting with Torch

1. Cut two pieces of sheet metal 4 by 8 in.

2. Place the two pieces of sheet metal one on top of the other with the edges flush, and use a Vise-Grip wrench to hold them together for welding.

3. Tack-weld the four corners.

4. Weld the 8-in. edges together without using a filler rod.

5. Make a chalk line along the 8-in. sides on the top piece, 1 in. from the edges.

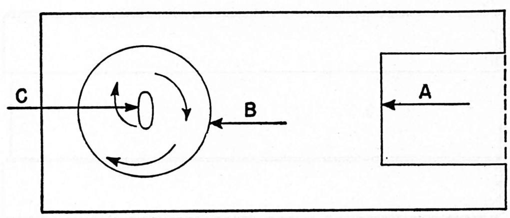

Fig. 3-6.

6. Connect the cutting attachment in the torch and insert a No. 2 cutting tip.

7. Set the regulators at 5 lb. acetylene and 20 lb. oxygen.

8. Light the torch and adjust it to a neutral flame.

9. Cut out the center from the upper piece without cutting the lower piece (Fig. 3-8).

a. To start the cut, preheat a small spot to a cherry red on one end of the chalk line.

b. The oxygen valve on the torch is kept wide open while cutting. Press the cutting oxygen lever down, and holding the torch at as small an angle as possible between the tip of the torch and the sheet metal, move as fast as the cut progresses (Fig. 3-9).

c. If the angle between the torch and the sheet metal is too great, the lower piece will be preheated and cut.

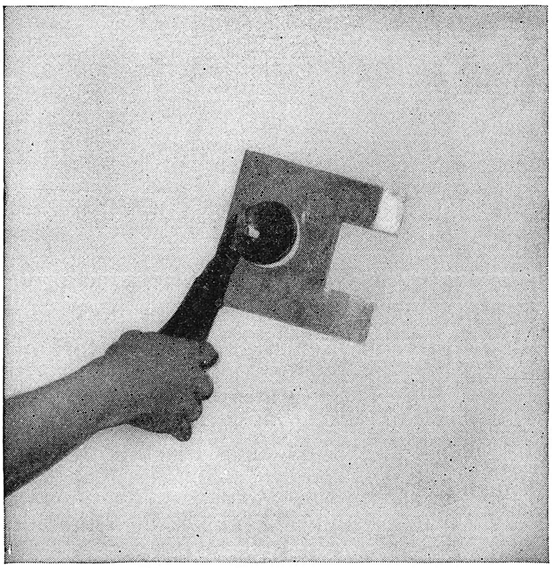

Fig. 3-7.

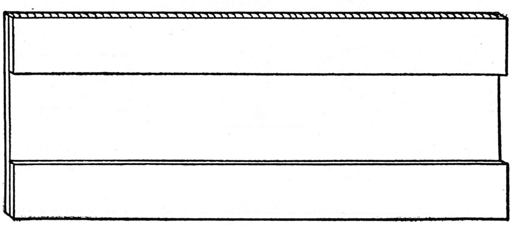

Fig. 3-8.

Procedure 3—Cutting with Hack Saw

1. Cut a piece of sheet metal with a hack saw.

a. Keep as many teeth as possible in contact with the metal (Fig. 3-10).

b. This prevents the teeth from breaking off the hack-saw blades. The teeth will break if the edge of the sheet metal is allowed to get between them.

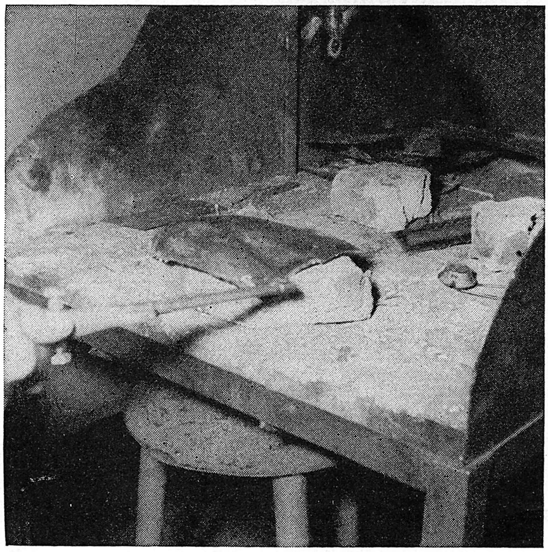

Fig. 3-9.

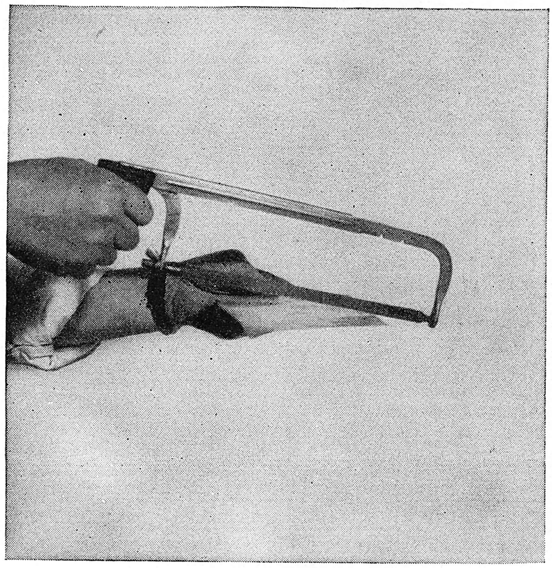

Fig. 3-10.

Straightening Sheet Metal

The faces of the hammers and the surfaces of the dollies must be kept smooth and clean. A rough hammer and dolly will transfer the same roughness to the sheet metal being straightened. Body-deadening material will often stick to the dolly. Be sure to clean the dolly before using it for straightening. Any nicks on the surfaces of hammers and dollies must be sanded out.

Using the correct crown dolly and hammer is important. The crowns of the dolly and the hammer must be such that the surfaces contacting the sheet metal will have clearance at the edges. When using a dolly on a high-crown panel, the dolly must be higher crowned than the panel.

The secret of sheet-metal straightening is best expressed with "dolly on the low spot and hammer on the high spot." In other words, the dolly is placed on the low spot on the underside, while the hammer drives the high spot down. The dolly, being heavier, does most of the work and makes straightening easier.

Figure 3-11 shows a damaged panel. There is a ridge all around the damage. With a dolly *D,* begin bumping out the damage by striking the blows next to the ridge at *A*. Bump out the damage from *A* to *B* and from *C* to *B*. Always bump out from around the ridge toward the center.

Figure 3-12 shows the damage bumped out leaving a ridge around the damage. Use a flat dolly *B* and a dinging hammer *A* to flatten down the ridge. A low-crown spoon *D* and a hammer *C* can also be used.

Figures 3-13 and 3-14 show a method of practicing the use of a pick hammer. Notice how the hammer is held, with the finger as the spot to be picked. Wrist motion must be used. Do not use arm motion. Practice striking the end of the finger until it can be done without looking at the point of the hammer. With this practice it will be easier to pick up a small spot on a panel where the point of the hammer cannot be seen, as in Fig. 3-15. The hand *A* is resting on the top of the panel, while the pick hammer *B* is raising a small spot from underneath. The procedure is the same as striking the point of the finger.

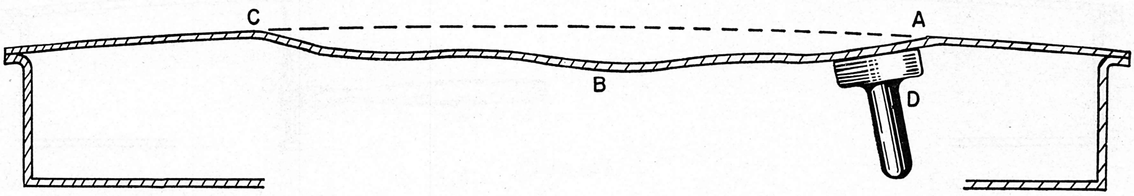

Fig. 3-11.

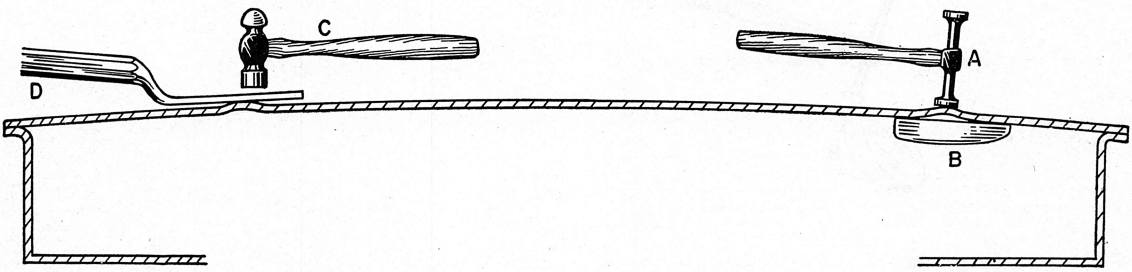

Fig. 3-12.

Do not strike a hard blow. The *lower surface* of the low spot should not be raised above the upper surface of the panel. When this is done, too much metal is filed away in smoothing the surface and a hole results.

Figures 3-16 and 3-17 show how the corner of a dolly can be used to raise a low spot that cannot be reached with a pick hammer. Locate the low spot with the corner of the dolly *B* by tapping on the top of the panel with a hammer *A* until the corner of the dolly is in the center of the low spot. This can be determined by both sound and touch. Strike a light blow next to the dolly while exerting pressure on the dolly. In this way the dolly will push up the low spot (Fig. 3-17). This

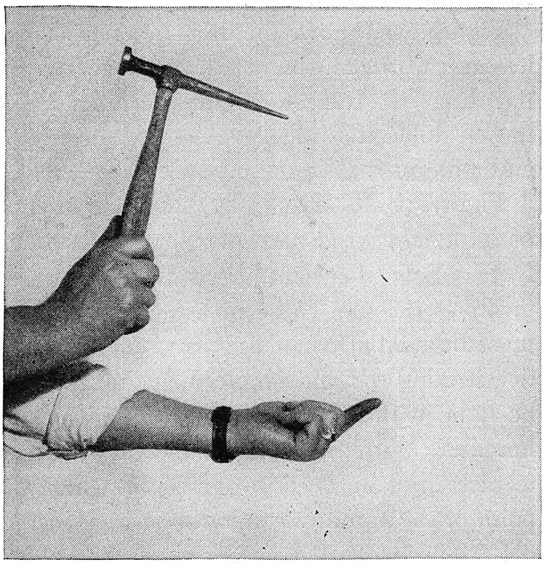

Fig. 3-13.

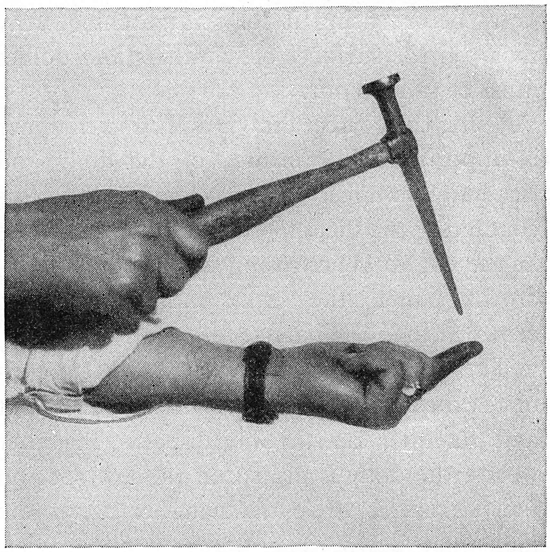

Fig. 3-14.

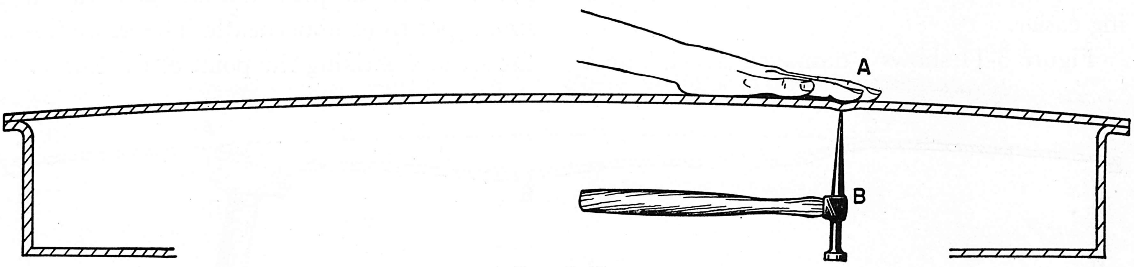

Fig. 3-15.

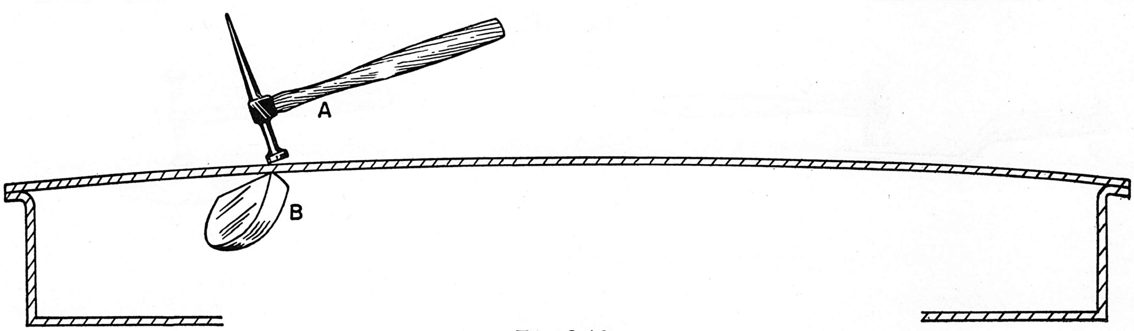

Fig. 3-16.

procedure can be used in many places where there is not room enough for a pick hammer.

Figures 3-18 shows how a long pick *A* can be used to pry up the low spot when there is no room for using a dolly.

Figure 3-19 shows a method of picking up low spots on a panel. To keep the panel from springing up when picking, place a dolly *A* next to the low spot while picking up the low spot with a picking hammer *B*.

Figure 3-20 shows how a dolly spoon *B* can be used as a dolly.

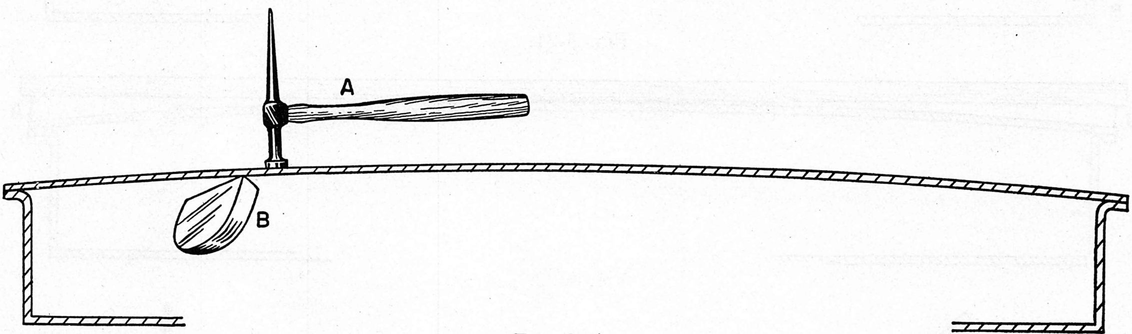

FIG. 3-17.

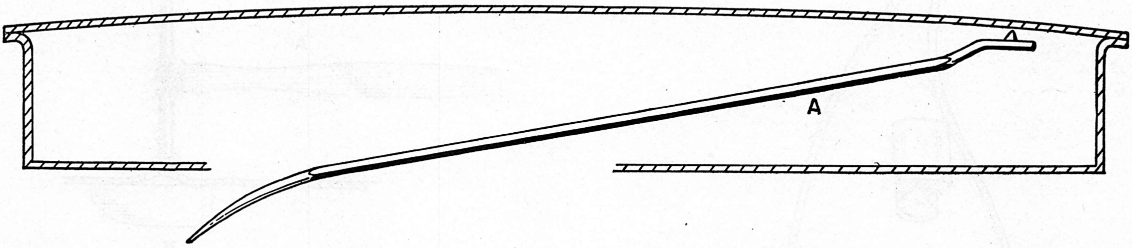

FIG. 3-18.

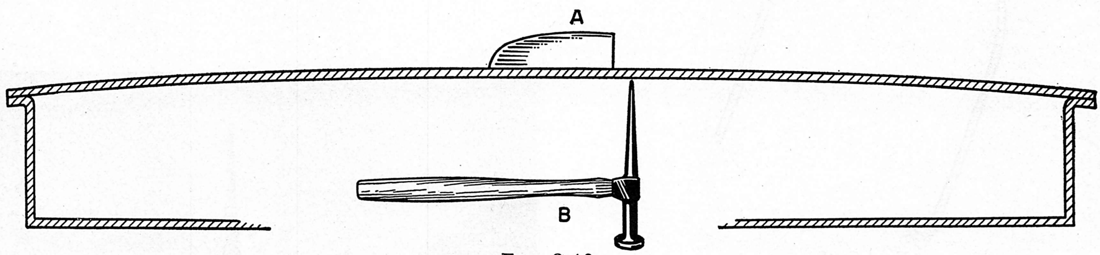

FIG. 3-19.

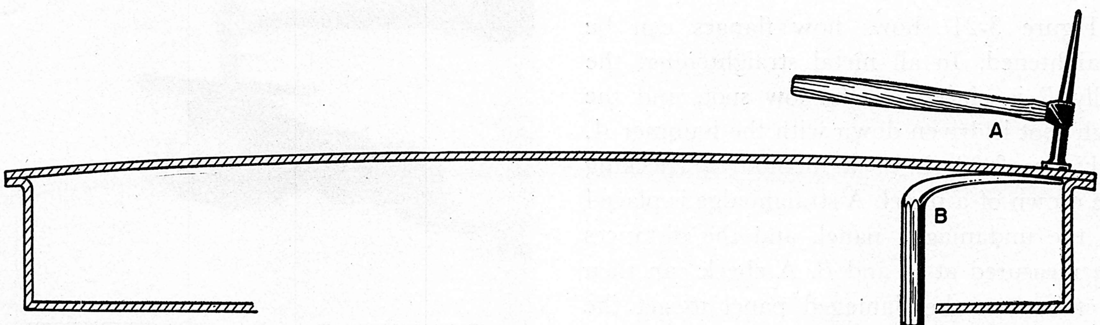

FIG. 3-20.

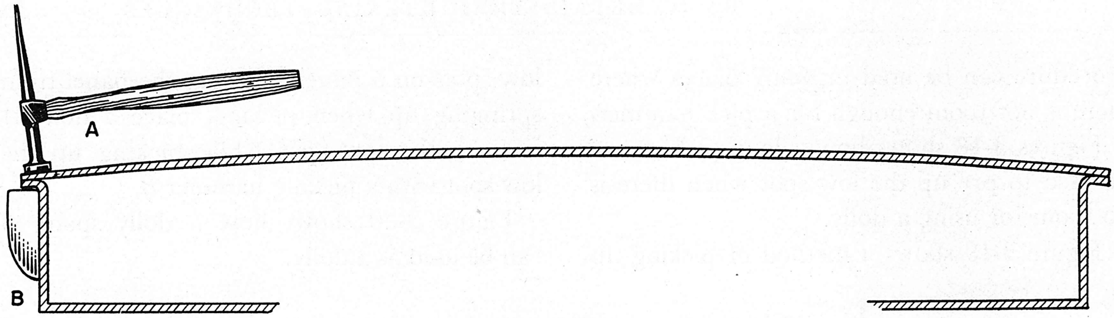

FIG. 3-21.

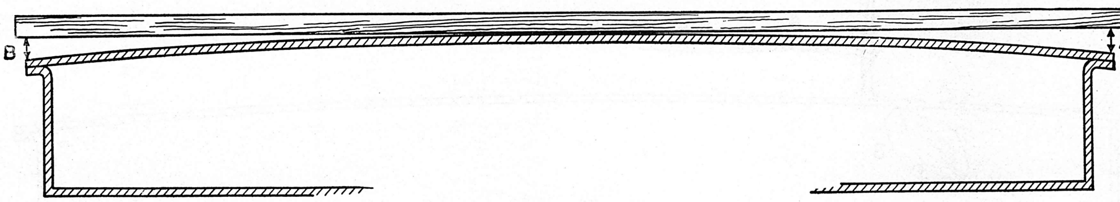

FIG. 3-22.

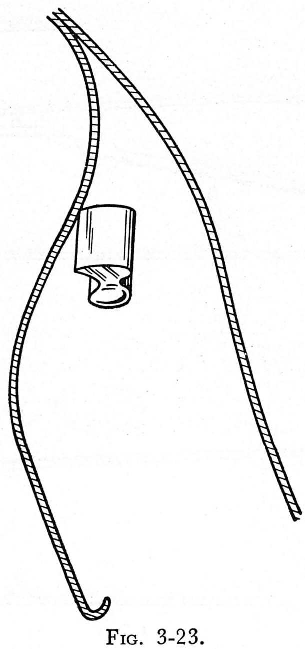

FIG. 3-23.

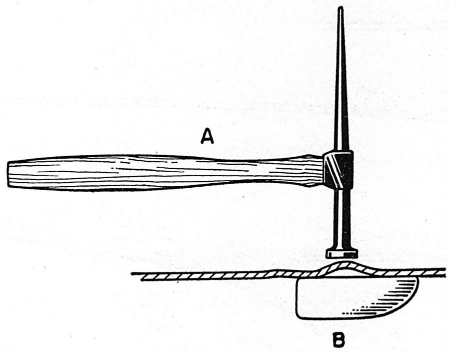

FIG. 3-24.

Figure 3-21 shows how flanges can be straightened. In all metal straightening, the dolly *B* is placed on the low spot, and the high spot is driven down with the hammer *A*.

Figure 3-22 shows a method of checking the crown of a panel. A straightedge is placed on the undamaged panel, and the distances are measured at *A* and *B*. A check can then be taken on the damaged panel to get the proper crown. When the crown is too high,

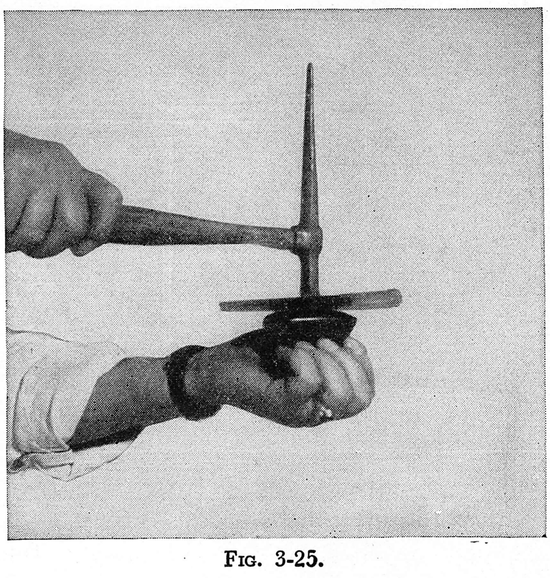

FIG. 3-25.

the panel must be shrunk to maintain the correct body lines.

Figure 3-23 shows how a dolly can be used to raise low spots in a limited space and where a pick hammer cannot be used.

Figure 3-24 shows the position of the dolly *B* and hammer *A* in peening out low spots. Again, the dolly is on the low spot and the hammer is on the high spot.

Figure 3-25 shows "on" dolly blows, and Fig. 3-26 shows "off" dolly blows. "On" blows stretch metal; "off" blows merely straighten it.

Figure 3-27 shows how a high and a low spot can be located by feeling with the hand. The hand is moved back and forth slowly. When the hand is moved over the panel rapidly, the high and low spots cannot be felt. The same is true when moving the hand too slowly. With practice the body mechanic develops the ability to feel the high and low spots.

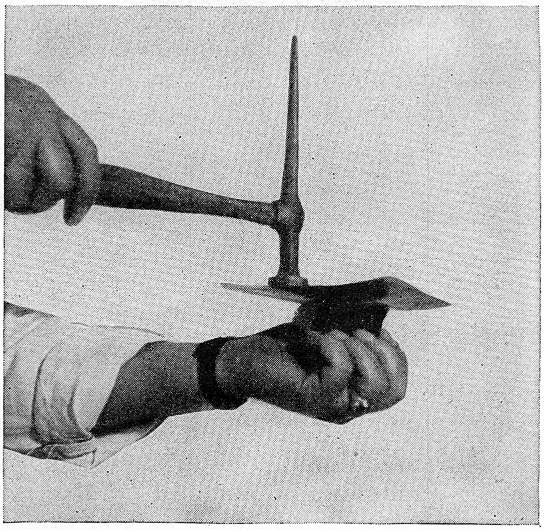

FIG. 3-26.

FIG. 3-27.

Making Templates

A template can save the mechanic much time and take the guesswork out of many body jobs. Templates are necessary when checking curvatures of center pillars, doors, trunk gutters, and when using short cuts in top-panel replacement.

Figure 3-28 shows how a template is made for checking the rear-quarter panel post for the correct curvature. A piece of cardboard is placed against the edge of the door, and a chalk line is drawn on the carboard along the edge of the door. When the cardboard is cut along the chalk line, it becomes a template with the curvature that the rear-quarter panel post should have.

Figure 3-29 shows how the template is used for checking. The same template can be used for the other side of the body. After making the template, it should be labeled (with the year, model, make, and the section for which it was made), and filed for future use.

Figure 3-30 shows a template for top-panel replacement when a short cut can be used. The new top panel is cut from the end of the drip molding to the arrow on the template.

By placing the template in the top window opening, the cut can be accurately determined.

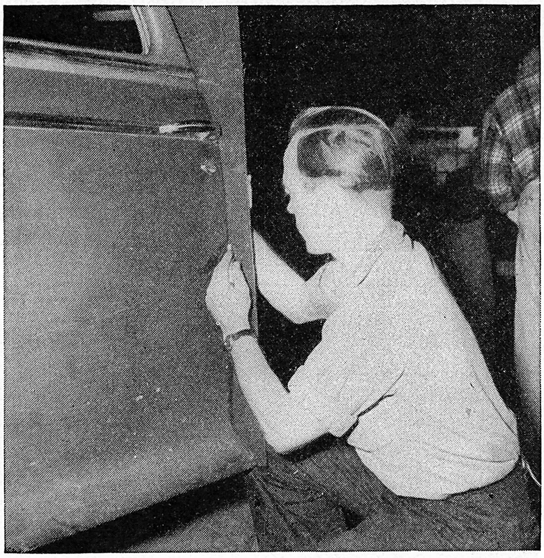

Fig. 3-28.

The same procedure can be used on the front end of the top panel when using a short cut.

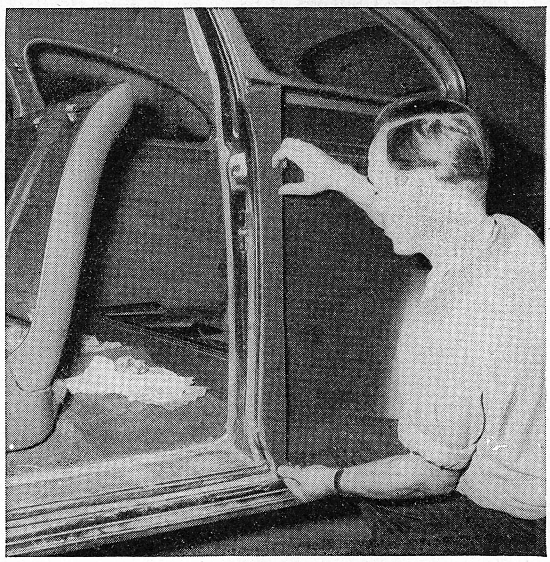

Fig. 3-29.

Using a Body and Fender Machine

Pneumatically operated body and fender machines, such as the Rams-Head shown in this section, save the experienced metal man many hours of labor in dinging out panels, etc.

The direction of movement of the machine is extremely important. Always avoid using a circular motion, since this tends to draw the metal to the center of the circle. Use only straight, long, even strokes in the direction best suited to the type of the damage. Extend the stroke into the undamaged part of the metal. If working near an edge, let the stroke go all the way to the edge. Any metal that is dented is apt to be stretched a little. By following these directions, the stretched metal will be distributed in most cases so that it will not be noticeable. In case too much stretch is still present, the metal can be shrunk in the usual manner, using the Body and Fender Machine for final finish.

Be sure to regulate the air pressure. Too much pressure is harmful to light-gauge metal. Many operators have found that excellent results can be obtained on flat sur-

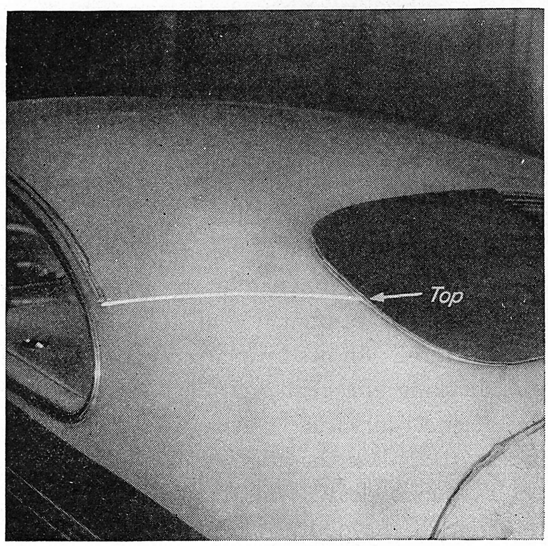

Fig. 3-30.

faces by using low pressure. In many cases it is surprising what 35 or 40 lb. pressure can do. If needed, the pressure can be increased. Doors, hoods, side panels, turret tops, or any panel with a large expanse of metal that is flat or only slightly curved should be worked with the lowest air pressure that will do the job. The usual range is between 50 and 75 lb. pressure; but, in some cases, such as the rear part of a hood, it is well to start even lower and build up to the necessary amount. For fenders the average pressure used is between 60 and 80 lb. For heavy truck fenders, increase as much as necessary. Some of the new fenders have large side areas much like a body panel (to work), and the metal is light. The air pressure must be regulated accordingly. When properly used, it will not only restore the original shape, but also smooth the metal so that hand finishing is made easier. Remember that long dollies give a leveling and ram clearance. The smaller dollies are for use only in small areas of extreme shapes. When using small dollies, it is well to use less air pressure to eliminate stretching possibilities. After making sure that the right guides and dollies have been selected, let the machine do the work. If the frame is held too tightly, it is possible to exert a leverage which can prevent the guides from doing their job. Hold the frame lightly, just enough to balance the weight of the arm.

The purpose of the air gauge and regulator is to control the air pressure near the machine. This is necessary because of the drop in air pressure often found between the compressor and the outlet. This sometimes amounts to 15 or 25 lb. where a long line is being used. After determining the best pressure for each type of work, set the regulator before starting. This will assure uniform results.

Always make sure that there is plenty of room under the work to allow free movement of the frame to be used. Also check for obstructions, to make sure that the stroke can extend well past the edge of the actual damage. A few minutes extra time spent in preparation may make the difference between a perfect job and one not quite so good. Setup time is not wasted time, since a power tool straightens metal so much faster than hand methods.

Ram clearance is adjusted at the factory to $\frac{3}{32}$ in. between the ram and the bell guides. If contrary, loosen the collar screw, and turn the collar until factory adjustment is obtained; then lock the collar screw tight. Ram clearance should never be more than $\frac{3}{32}$ in. (Fig. 3-31).

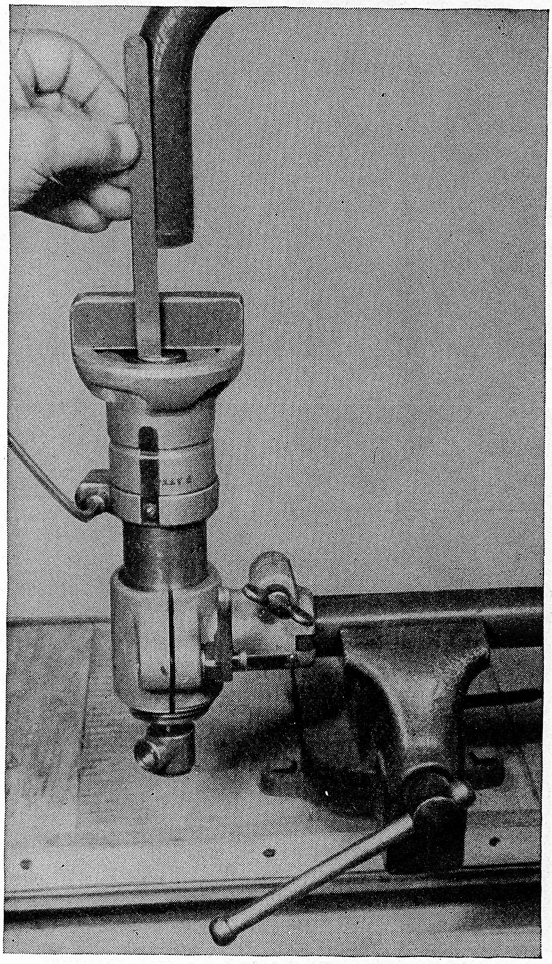

FIG. 3-31.

Lift the machine dolly against the fender, and turn the machine down with large vise-action screw threads. It is not necessary to lock the machine with handle when working on fenders, only on turret tops or doors (Fig. 3-32).

For good work, it is very important to scrape dirt and tar off the bottom of fenders; the finish will be complete and perfect on the top surface if this has been done.

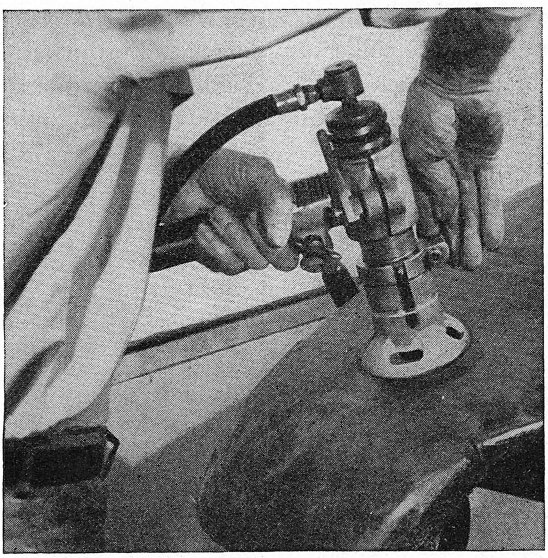

Fig. 3-32.

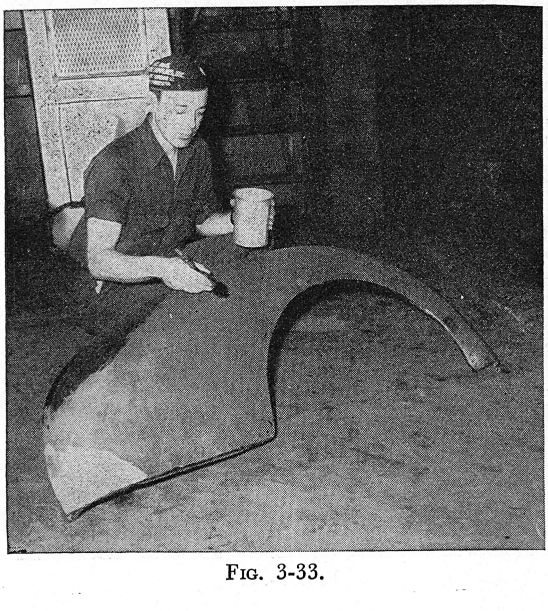

Fig. 3-33.

Provide a brush and a can with oil, part kerosene. Apply oil liberally on the under surface, lightly on top. The machine will slide easily, and the dolly will swivel freely in curvature as the machine is moved over the surface (Fig. 3-33).

Figure 3-34 shows how to hold the machine. Notice the vise-action screw threads for opening and closing the machine. Do not loosen collar, as it will displace the ram and bell-guide adjustment. Grip and push with the right hand and support lightly with the left, or vice versa. Push back and forth, making long strokes to distribute the metal (Fig. 3-35).

Figure 3-36 shows how to slide the machine. Don't run the machine in circular lines as at *A*. Starting at one end, slide the machine from the good surface to the edge, diagonally over the fender or the panel to the other end, as at *B*. Then return, as at *C*, crossing the lines *B*. Finally cross all lines lengthwise, as at *D*. Study the lines, as shown in Fig. 3-37.

Figure 3-38 shows the correct dollies to use

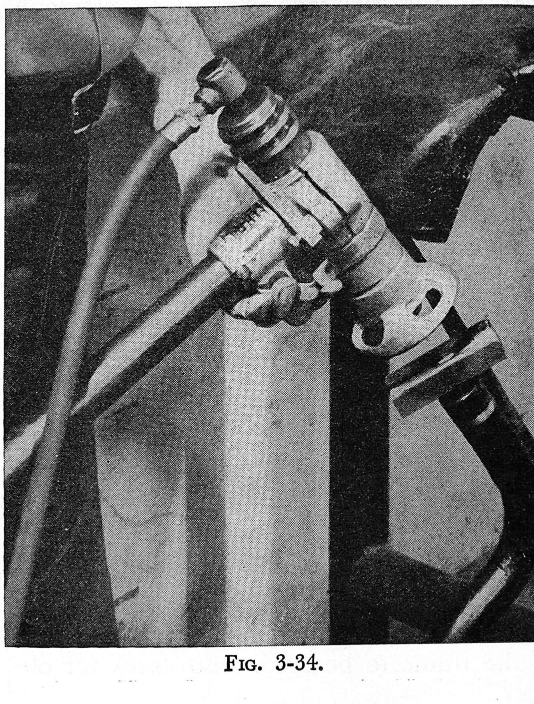

Fig. 3-34.

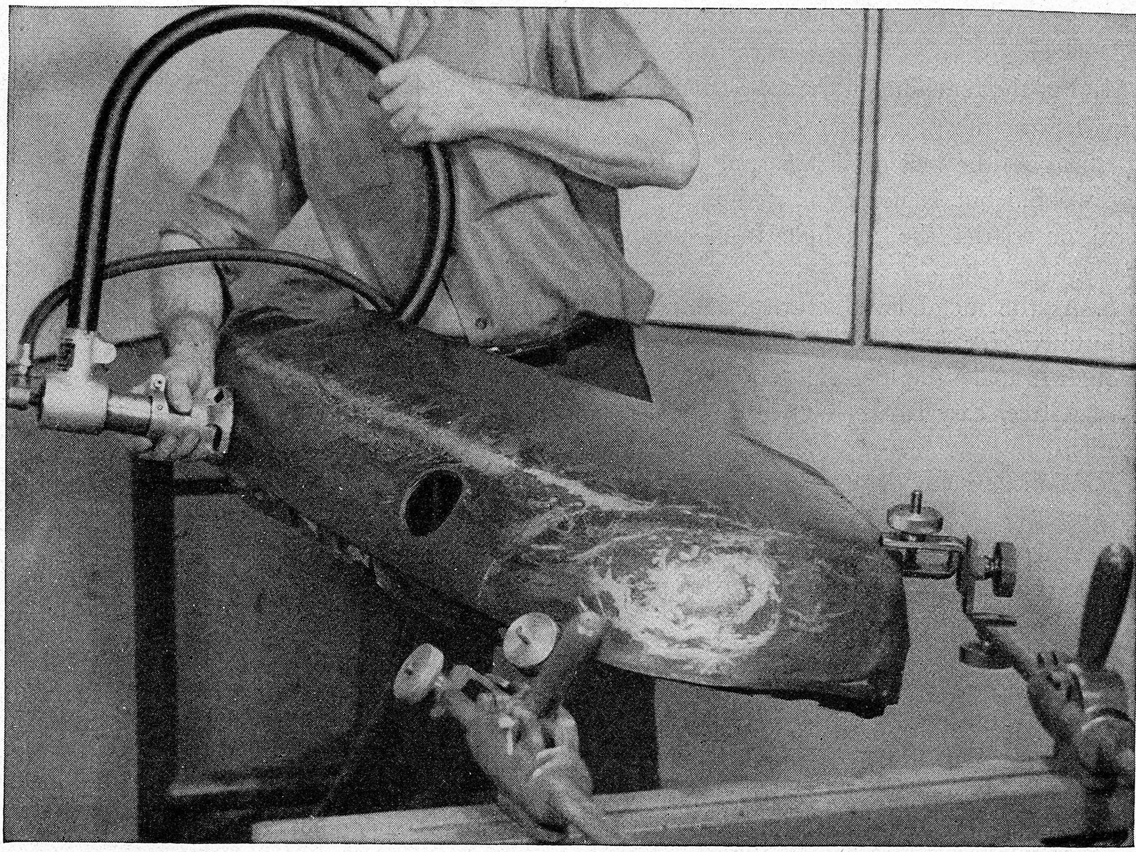

Fig. 3-35.

on a fender. Dolly 57B is used on the whole fender except at *C;* there, use 57C or 57A.

NOTE: 57C and 43C will leave the fender wavy when used in place of 57B or 57A. The foundation of a fender is between the auto body and the white line, the full length of the fender. Be sure to machine that area first, and next machine below the white line.

For fender wells, skirts, below trunk lids, front and back of latest style fenders, and numerous other close quarters, use 32D.

Procedure on Fenders

1. Remove the wheel after raising it from the floor with a jack and placing a stand under the frame for safety. A jack under the frame allows the hub to drop on spring tension, allowing more space for free movement of the machine frame.

2. Shape the damaged part to the original contour in the usual manner with a hammer and dolly, paying special attention to aligning outer edge.

a. The main panel of the fender need only be brought back to general contour, but the edge should be lined up well and the flange shaped as necessary.

b. If the edge is in line, the Rams-Head machine will work the balance of the metal to the proper shape and level.

3. Remove the tar and dirt from the underside.

a. Apply a generous coating of oil under the fender and a light coat on the top. This will allow the tool to slide easily and the dolly to revolve freely.

b. Mix one part of kerosene with three parts of motor oil for this coating.

c. If some tar is left under the fender, the kerosene will help to soften it.

4. Put the machine on the work, moving it rapidly over the rough places.

a. Adjust the bell until it is snug and will not wobble but is not tight enough to pull hard or restrict the machine from moving freely.

b. As the metal level returns, tighten the adjustment for final finish, but never tight enough to make the tool pull too hard.

c. A free, easy stroke is essential for good results.

5. Work systematically with long, even strokes.

a. Always work the upper contour of the fender into shape first, following down the skirt last.

Procedure on Quarter Panels

Figure 3-39 shows the Rams-Head used on a quarter panel. The plate bell guide supports the machine at right angles with the work and removes waves. The 33½-in. frame is used on large panels and turret tops. This frame reaches past the center of the top.

Procedure on Turret Tops

1. Before starting on a turret top, make sure that the frame is in proper alignment and that the doors operate properly.

2. Use a body jack to bring the top to its original alignment, contour, and shape (see chapter on Use of Hydraulic Body Jacks, p. 52).

3. Remove sound-deadening material, and apply oil with a brush.

4. Now the top is ready for the pneumatic hammer. It is best to work first around the outer edge near the roof rails, since this will remove more of the tension from the center. Work the corners of the top next, using a diagonal stroke and working the metal from the center toward the outer edge. Work back with a cross-diagonal stroke (Fig. 3-40).

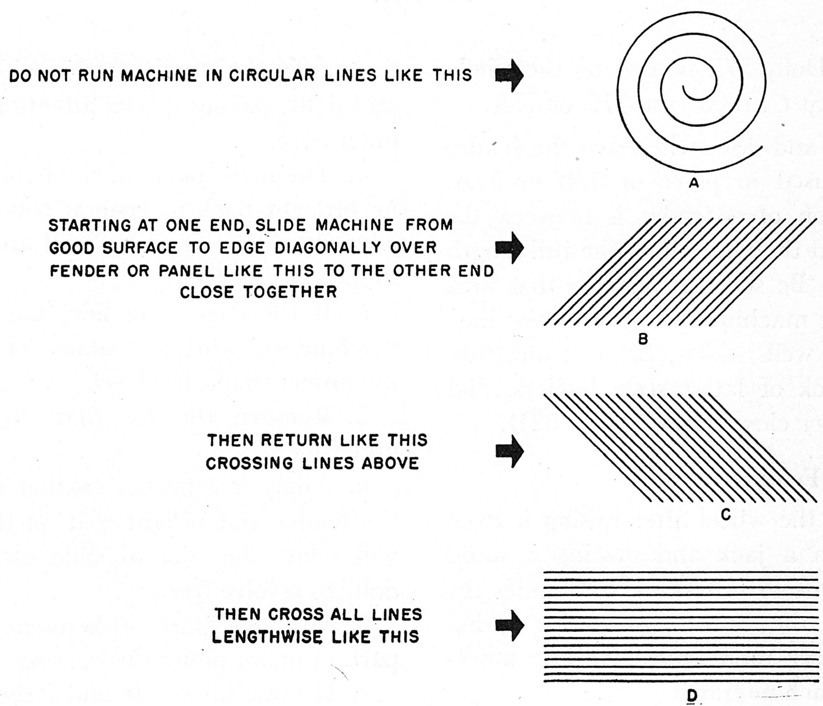

Fig. 3-36.

5. When the original contour has been brought up, work straight across and lengthwise on the top for the final finish. Be sure to balance the frame of the machine without exerting a leverage, so that the guides operate on a level with the work. Figures 3-41 and 3-42 show a track and trolley used to support the Body and Fender Machine at a right angle on curved turret tops and large flat panels. The track provides a greater span, bridges weak portions, and prevents the unfinished turret top from sagging.

Figure 3-43 shows a sheet-metal chisel used to cut sheet metal. The Body and

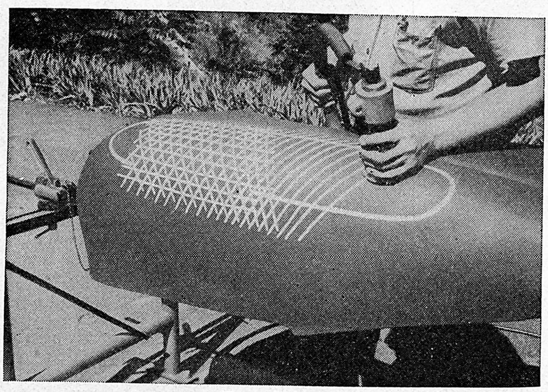

Fig. 3-37.

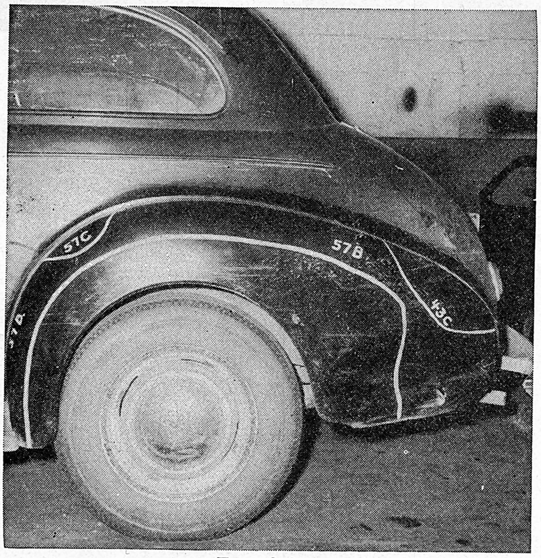

Fig. 3-38.

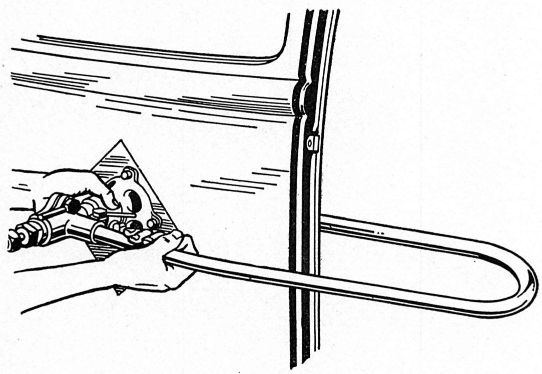

Fig. 3-39.

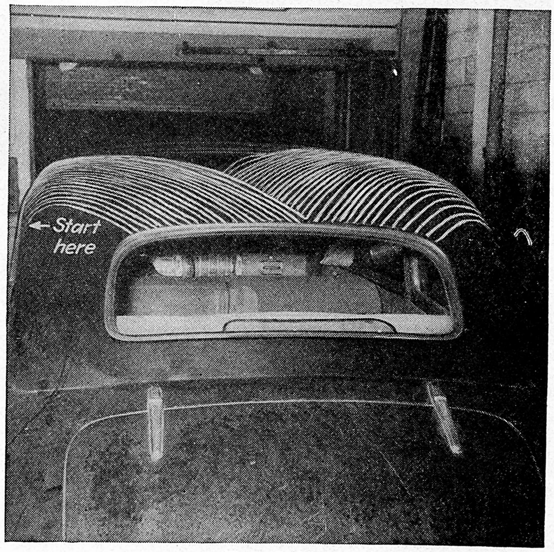

Fig. 3-40.

Fig. 3-41.

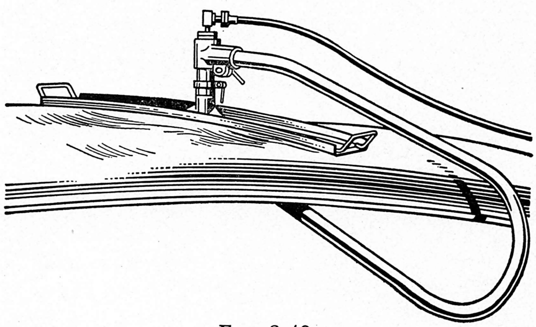

Fig. 3-42.

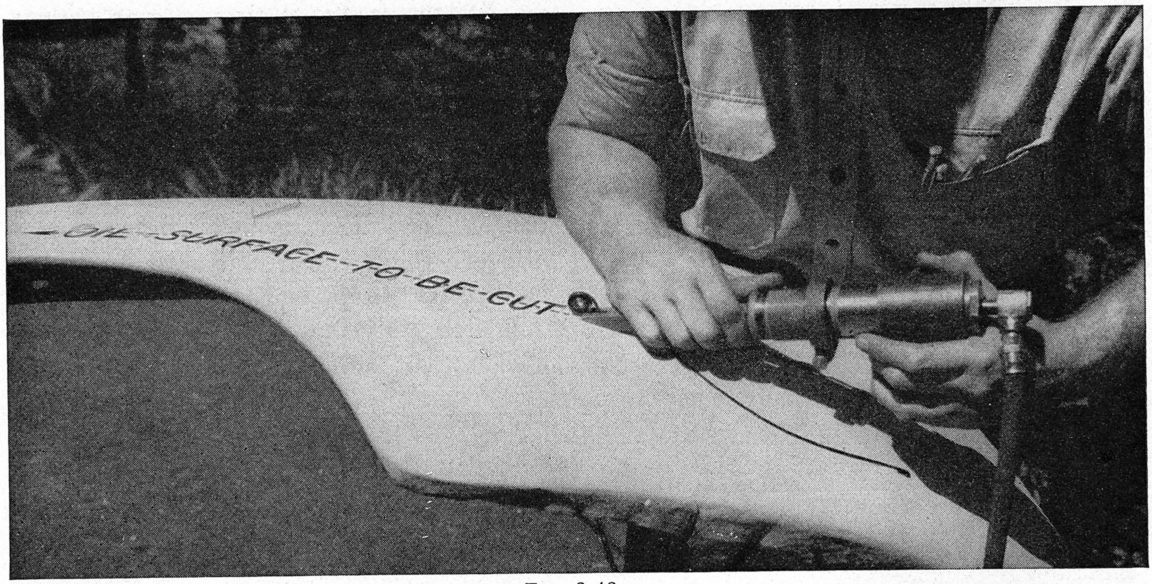

FIG. 3-43.

Fender Machine is used without the frame. A small hole is drilled in the sheet metal to begin the cut.

QUESTIONS

1. How is a disk sander moved?
2. When cutting a circle from the inside of a piece of sheet metal, how is the cut started?
3. At what angle is the torch held when cutting sheet metal?
4. How is the secret of metal straightening best expressed?
5. Where is a template used in body work?
6. What are "on" and "off" dolly blows?
7. Is direction of movement of a fender machine important?
8. How is a fender machine moved across the fender?

CHAPTER 4

Types of Body-panel Aligning

Aligning Trunk Lids

The reasons for trunk-lid misalignment are numerous. The trunk-lid opening may be out of square and not lined up properly. The hinges may be bent. Sometimes the lid is forced shut when the trunk is too full, especially too full on one side. A rear fender may have been damaged at some time, pushing the trunk side panel in and down, leaving the opening low on one side. On some makes of cars the brace at the front of the trunk may have loosened and allowed the trunk-lid opening to get out of square.

Trunk-lid hinges are usually adjustable up and down and sideways. Where the hinges are stationary, they can be bent to make them line up.

Whatever the reason for misalignment, the following procedure will give excellent results.

Tools and Equipment

Hydraulic jack; socket wrenches; screw drivers; wood block 4 by 4 by 8 in.; telescope tram or rule.

Materials

Weather-strip cement.

Procedure

1. Check closely at the following points: clearance around the trunk lid; high corners; lid higher at the top than the body.

2. Loosen the trunk lid on the hinges to obtain the proper clearance around the lid.

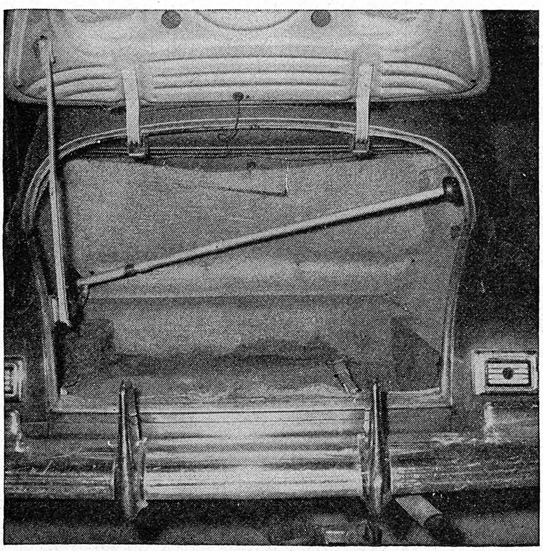

FIG. 4-1.

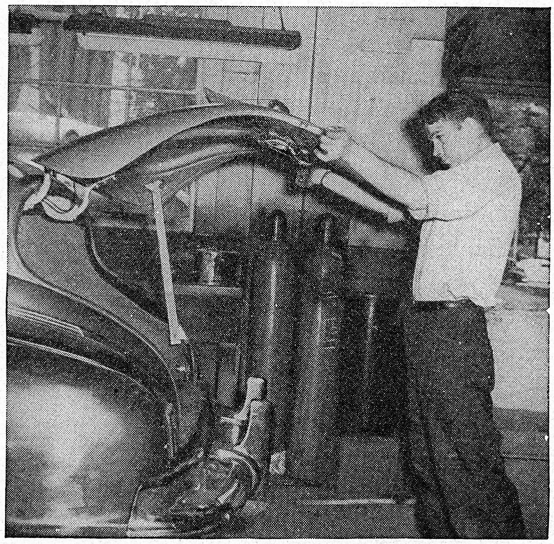

FIG. 4-2.

FIG. 4-3.

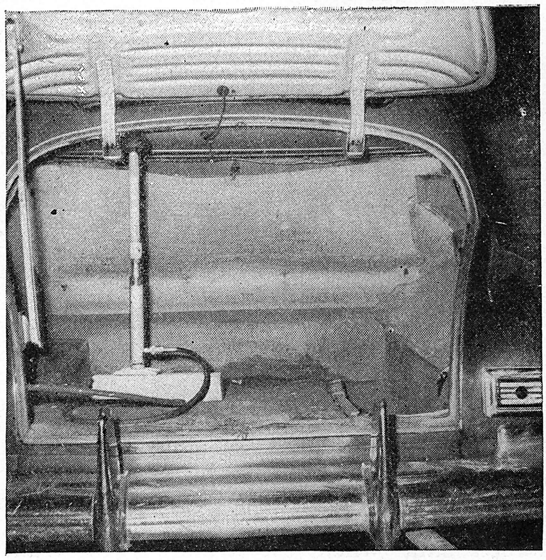

FIG. 4-4.

3. Adjust the striker plate by moving it in until there is a slight pressure on the rubber to make a watertight seal.

4. Measure the trunk-lid opening diagonally from all corners to determine if the opening is square.

a. Square the opening with the hydraulic jack (Fig. 4-1).

5. When one lower corner of the trunk lid is high, open the trunk lid and sight to determine if the lid is twisted (Fig. 4-2).

a. Twisted lids are usually caused by closing the trunk lid when the trunk is overloaded on one side.

6. To straighten a twisted lid, place a wood block under the low corner and press down the high corner (Fig. 4-3).

7. If the trunk lid is not twisted and one lower corner is high, jack up the upper corner of the opening which is diagonally opposite the low corner (Fig. 4-4).

8. When the top of the lid is higher than the body, check to see if the hinges are adjustable at both ends.

a. This condition is usually caused by forcing the trunk lid open too far and bending the hinge arms.

9. Where hinges are adjustable, loosen both hinges on the body and move the hinges toward the front of the car to adjust the trunk lid for the proper clearance.

10. Where hinges are not adjustable, remove the trunk lid and bend the hinges down until the trunk lid and body are flush.

NOTE: Bend the hinges a little, fasten the trunk lid to the hinges, and check. Repeat until the trunk lid is aligned. If the trunk-gutter rubber is loose, glue it with weatherstrip cement.

Adjusting Hood Hinges

Before attempting any adjustment, examine the hood closely to determine where the hood is out of line. Check the clearance between the rear edge of the hood and the upper and lower cowl panels. When the hood extends to the front edge of the doors, check the clearance there. Raise and lower the hood to see whether the hood has enough clearance at the upper cowl panel and does not catch. It must be established that the front end, namely, fenders and grille, and the front striker plate are lined up. The body mechanic should now know where adjustment is needed.

Never take anything for granted. Measure to make sure, and measure accurately. Hood-hinge adjustment is simple when done correctly but can cause no end of difficulty when proper procedure is not followed.

NOTE: Do not attempt to adjust the hood hinges without removing the hood and the hood-hinge springs.

Tools and Equipment

Socket wrench set; screw drivers; steel rule.

Materials

None.

Procedure

1. Check adjustment at the center of the reinforcement channel of the hood between the hinges (Fig. 4-5).

2. Remove the hood if proper adjustment cannot be made (Fig. 4-6).

3. Remove the hood-hinge springs (Fig. 4-7).

a. Hood and springs must be removed to release the tension from the hinges.

4. Work hinges up and down to see that they move freely.

5. Replace the hinge if the rivets are badly worn.

6. Check the hinge arms, and straighten them if they are bent.

a. The hinge-to-hood fastening plate must not extend beyond the edge of the fender (Fig. 4-8).

7. Lower the hinges and check the clearance between the hinge-to-hood fastening plate and the fender (Fig. 4-9).

a. Clearance must be the same along the entire plate.

8. Loosen all bolts on the hinge-to-cowl plate if either end of the plate has more clearance than the other end.

a. Hinge-to-hood plate must have equal clearance at both ends.

9. Tighten the hinge-to-cowl bolts while the hinge-to-hood fastening plate is lying on the upper edge of the fender.

10. Work the hinge up and down to see that it moves freely, and check the clearance again.

11. Measure the distance from the back

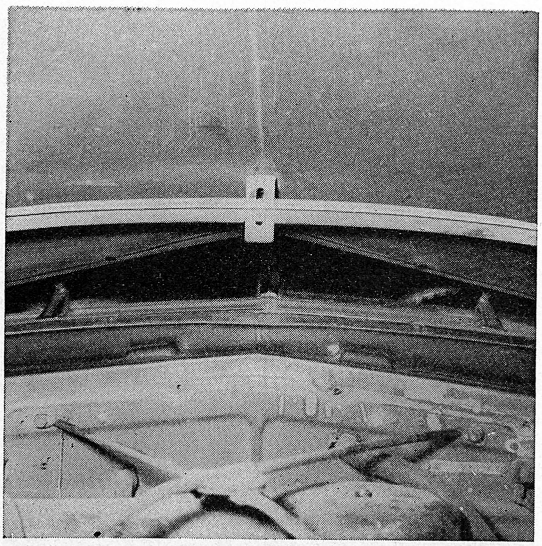

Fig. 4-5.

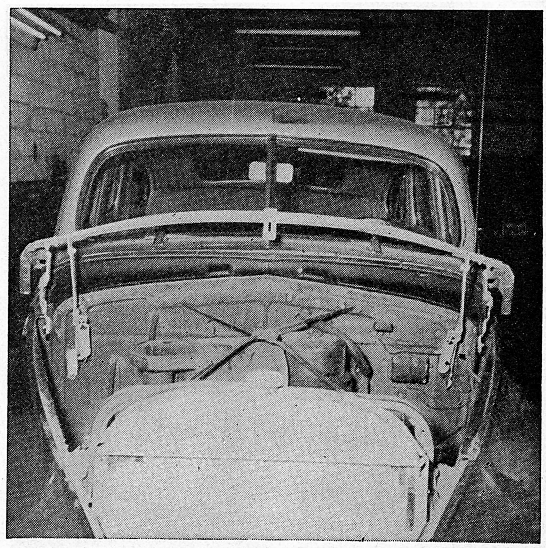

Fig. 4-6.

edge of the hood to the center of the first hole where the hinge plates fasten (Fig. 4-10).

12. Measure the distance from the center of the corresponding hole on the hinge-to-hood fastening plate to the front edge of the door or to the cowl (Fig. 4-11).

a. Example: If the distance from the rear edge of the hood to the center of the first hole is 4 in., the distance from the cowl to the first hole in the hinge-to-hood fastening plate must be 4¼ in.

b. When the hood extends to the front edge of the door, measure from the front edge of the door.

c. A clearance of ¼ in. is allowed between hood and cowl or the front edge of the door.

13. Adjust the hinges at the hinge-to-cowl bolts to obtain the proper measurement.

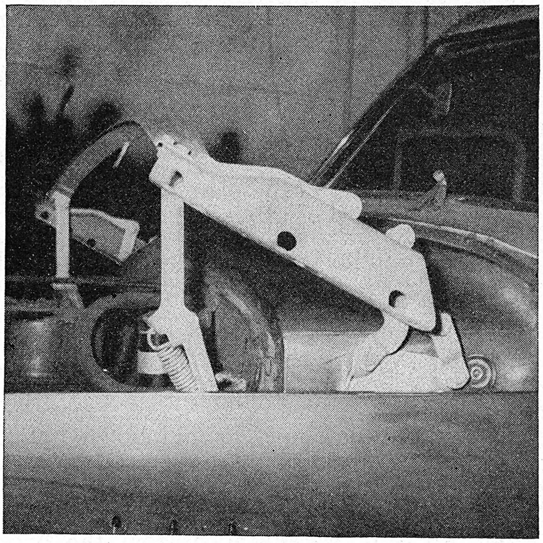

FIG. 4-7.

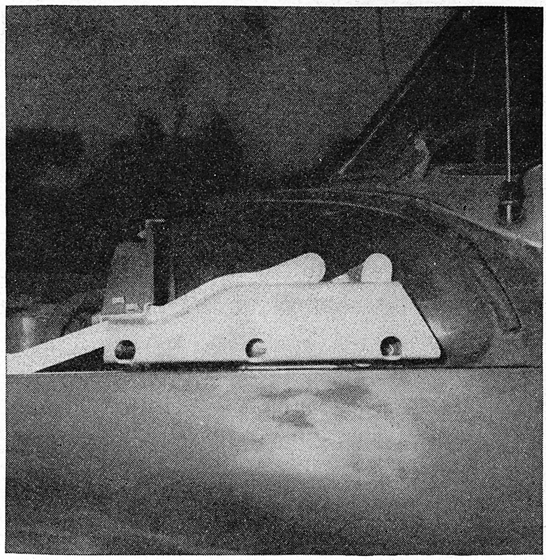

FIG. 4-9.

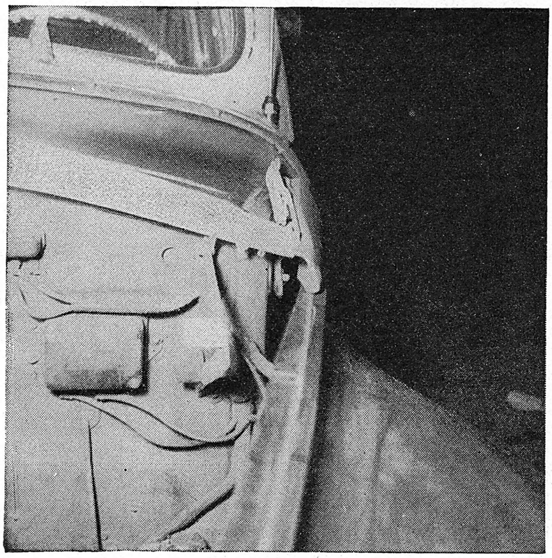

FIG. 4-8.

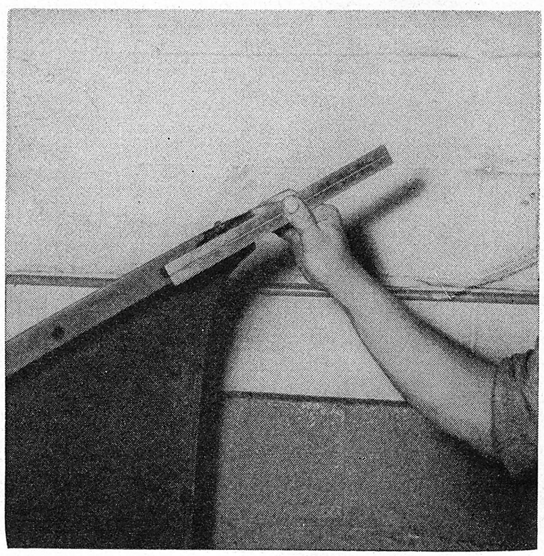

FIG. 4-10.

NOTE: Measure accurately, making sure both sides are the same. Always measure from the center of the hole. *This is extremely important.*

a. Make sure to keep the hinge-to-hood plate flat on the fender, as in operation 9.

14. Oil all hinge pivots.
15. Replace the hinge springs.
16. Install the hood.
17. Close and open the hood to make sure it has enough clearance at the top cowl panel.

a. If the hood catches on the top cowl panel, make adjustment at the center of the reinforcement channel (Fig. 4-5).

b. If all measurements have been accurately made but the hood does not fit at the front striker plate, further alignment must be made at the radiator saddle (see section on Straightening and Aligning Radiator Saddle, p. 68).

c. A properly adjusted hood will fit as shown in Fig. 4-12.

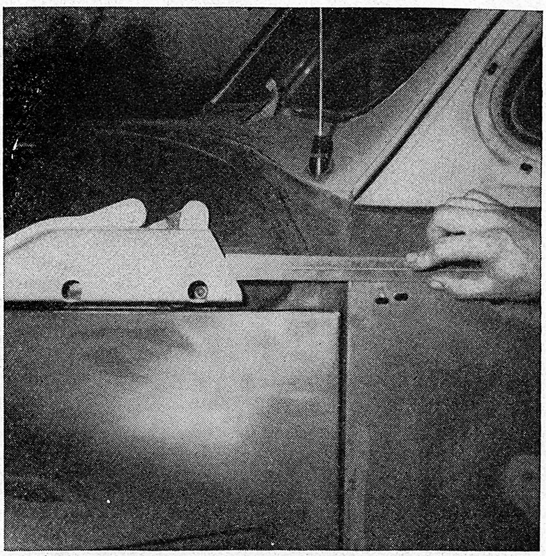

Fig. 4-11.

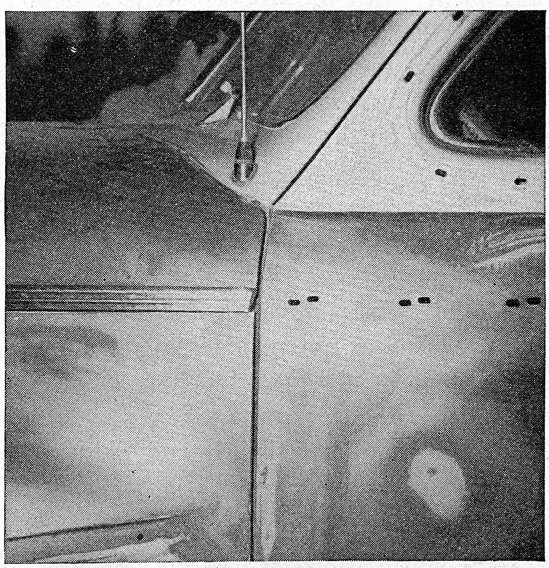

Fig. 4-12.

Aligning Door Hinges

Hard-closing doors are irritating, to say the least. Several conditions can be the cause. The dovetails and striker plates may be dry and beginning to cut. Dry lubricant applied to these parts will usually correct this condition. Sometimes doors are sagged. The dovetails will not line up, and this makes doors hard to close. When a corner of the door is in too far, closing will be difficult. When the door is too far in on the hinge side, it will catch the adjoining panel and the paint will be chipped off the panels.

All these conditions can be corrected with hinge adjustment, provided the door is not sprung or the door opening out of line. In such cases the door and the door opening must first be lined up.

Tools and Equipment

Screw drivers; socket wrenches; scratch awl.

Materials

Two wooden wedges; dry lubricant.

Procedure for Sagged Doors

1. Remove door handles, garnish molding, and upholstery panel.

2. Loosen the bolts of the hinge on the door (*A* and *B*, Fig. 4-13).

3. Close the door and line up the door in the door opening.

a. Wooden wedges placed between the door and the rocker panel are used to hold the door in alignment.

4. While the door is closed and held in alignment with the wooden wedges, tighten the hinge bolts.

a. When the door is opened, there might be a slight sag because the weight of the door was resting on the wooden wedges, in which case proceed as follows.

5. Place a mark on the door at the end of the upper hinge with the scratch awl (*C*, Fig. 4-13).

a. This mark serves as a guide when moving the door on the hinge.

6. Loosen the upper hinge bolts on the door.

7. Raise the door slightly and tighten the hinge bolts on the door.

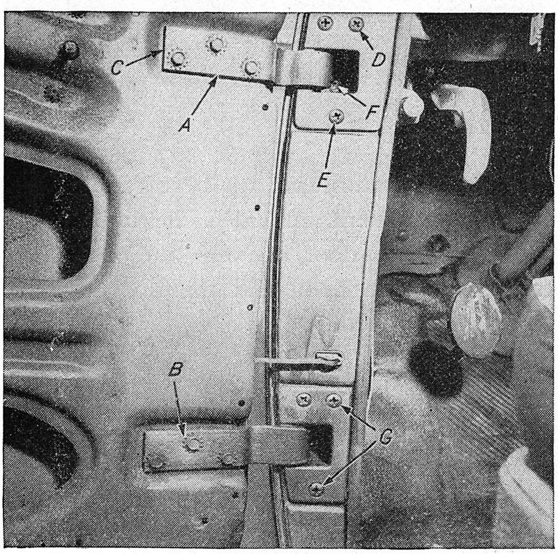

FIG. 4-13.

8. Check the door for alignment.

a. Check the dovetails to make sure the door is not pulled down at these points, as shown at *A* in Fig. 4-14 and at *A* in Fig. 4-15.

b. Dovetails can be moved up and down when the screws are loosened.

9. Adjust the striker plate by loosening the screws and moving the striker plate in or out (*B*, Fig. 4-15).

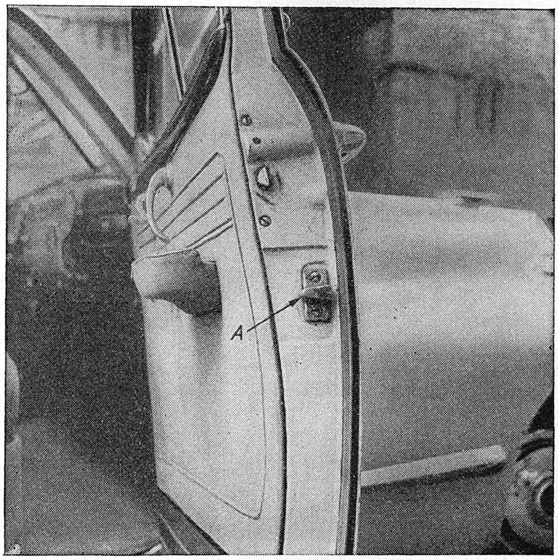

FIG. 4-14.

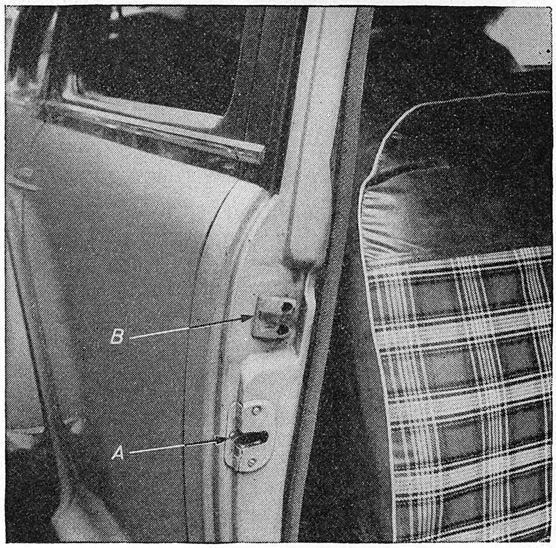

FIG. 4-15.

a. The door should close easily. There should be no play between the door latch and the striker plate.

b. Move the striker plate in only far enough to eliminate the play, and at the same time allow the door to close easily.

Procedure when Corner of a Door Is Out or In Too Far

1. Loosen screws holding top hinge to post (*D, E,* and *F,* Fig. 4-13).

a. Make a mark along the edge of the hinge as a guide to indicate how far the hinge is moved.

b. Some top hinges have four screws, while others have five.

c. Be sure to use the correct size and type screw driver to loosen the hinge screws.

2. Move the hinge in as far as it will go.

3. Tighten the screws and check for alignment.

a. If the door is too tight, move the hinge out a little.

b. If the adjustment on the upper hinge does not bring the door in far enough, perform the following operation.

4. Loosen the screws on the lower hinge on the post, and move the hinge out a little (*G,* Fig. 4-13).

a. The same type of screw is used on both upper and lower hinges. On the lower hinge they may be fewer in number.

b. Do not bring the door out farther than the adjoining panel.

c. When hinge adjustment does not correct the alignment, check for bent hinges or a sprung door. Replace bent hinges.

Questions

1. When is a striker plate properly adjusted?
2. How is a twisted trunk lid straightened?
3. Why should hinges be replaced when the rivets are worn?
4. What clearance is allowed between the hood and cowl or the front edge of the door?
5. Name causes of a hard-closing door.
6. Why should the hinge position be marked before removal?
7. How are striker plates adjusted; dovetails?
8. What points of the door should be checked before adjustments are attempted?

CHAPTER 5

Use of Hydraulic Body Jacks

For doing a satisfactory job on most major body repairs, a good hydraulic jack is a necessity. Such a jack consists of four elements—the pump, hose, ram, and attachments. The attachments permit the operator to make the necessary combination at the work spot.

This chapter is confined to the basic jack combinations for automotive body and fender work. The pictured combinations of the Porto-Power unit illustrated show basic fundamentals of the many push, pull, bend, lift, press, and clamp operations. The various combinations shown in this chapter should be used merely as guides and not as complete actual working diagrams. The operator who understands the various setups will be able to apply this knowledge in making actual combinations to suit his job.

Basic Methods of Operation

Figure 5-1. Misalignment of a door frame is usually checked by the fit of the door but may be checked by measurement of a good door frame as follows: Mark off a given distance on the door post from *B* to *A*; then mark off a given distance from *B* to *C*. Compare the measurement from *A* to *C* on both doors, and correct as needed.

Figure 5-2. In determining general body alignment, measure from the two points *A* to *B*; they should be the same. Likewise, the two measurements from *C* to *D* should be the same.

Figure 5-3. When a direct force cannot be applied in squaring bodies, force can be applied alternately on either side of the direct line of damage.

Figure 5-4. Work around the deepest point of damage, and gradually work in (right) to the center of the dent. In this way, kinking and further stretching of the metal will be avoided.

Figures 5-3, 5-5, and 5-6 give you reasons and methods for squaring a body with this type of hydraulic jack setup. Extensions are used to obtain the required length. Use diagonal and cross-body measurements to check the correct distances between pillars, openings, etc.

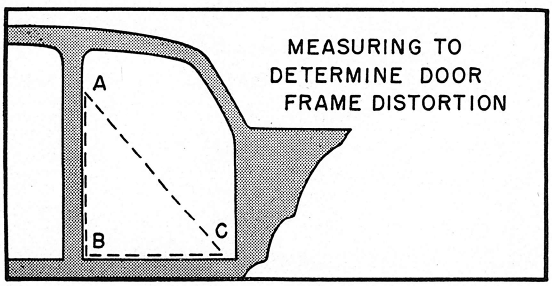

Fig. 5-1.

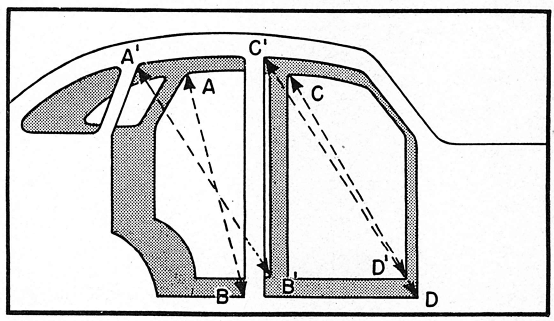

Fig. 5-2.

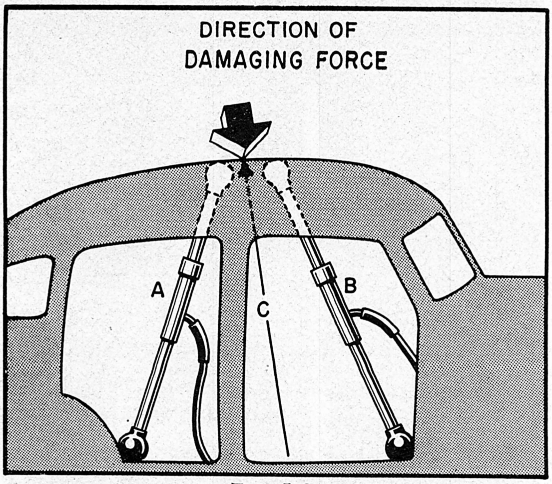

Fig. 5-3.

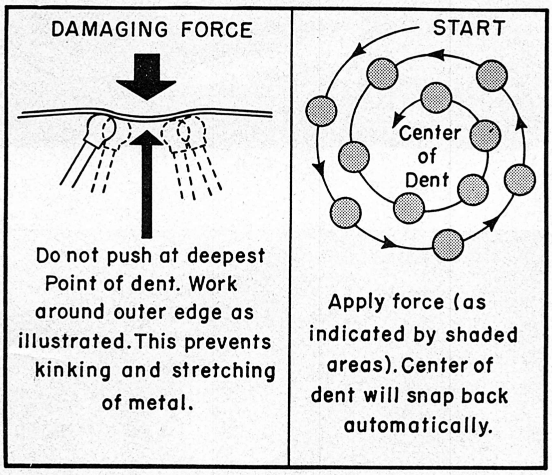

Fig. 5-4.

Figure 5-7 shows that several applications of pressure are needed to remove dents from turret tops. Rubber heads are used on both ends of the combination with the lower head set over a frame member. The force is applied around the edge of the dent to prevent stretching of the metal.

Figure 5-8 shows another stage in the same process of rotating pressure around the dent.

Figures 5-9, 5-10, and 5-11 show three different body spoons being used. These spoons are adjustable and are especially designed for body work. Each spoon is interchangeable with the fork and can be set in any of ten desired positions. Only one hexa-

Fig. 5-5.

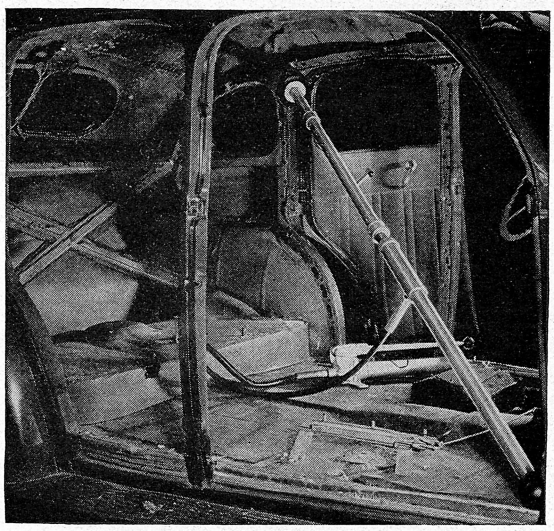

Fig. 5-6.

gon pin is used to hold the three different spoons. The selection of the spoon position is governed by the curvature of the body, or the body bend or dent, and the amount of available working space.

Figure 5-9 demonstrates that the cowl spoon can be used to good advantage on difficult cowl- and panel-straightening jobs. It's great for working in narrow, confined spaces; behind door posts, reinforcing brackets, mounted accessories, etc.

FIG. 5-7.

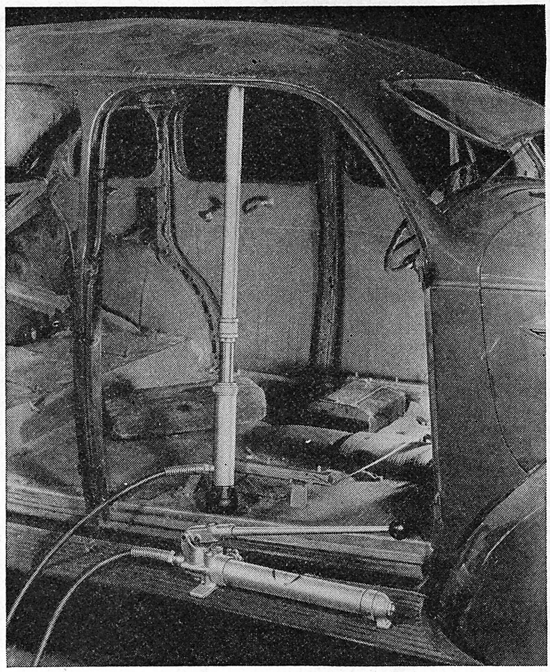

FIG. 5-8.

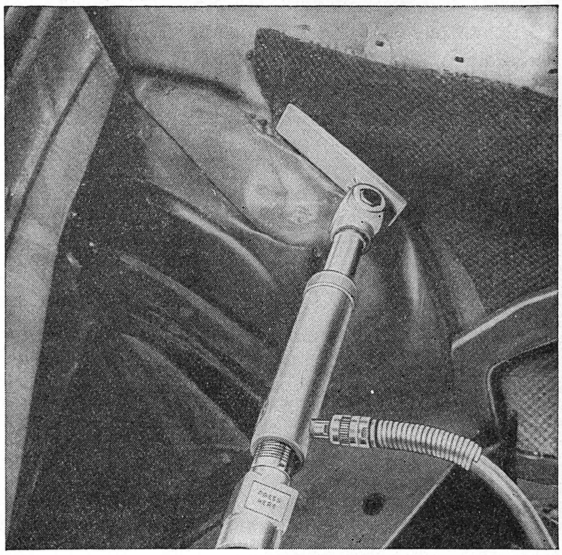

FIG. 5-9.

Figure 5-10 shows another spoon being used to line up a damaged roof and rear-quarter panel. Its broad surface speeds up straightening work, minimizes creases in the panel, and provides good dollying surface. With it are used the slip-lock extension and Flex-Head.

In Fig. 5-11 the adjustable roof spoon is used to push out this dented roof section over the door opening. The combination is anchored against the body frame on the opposite side. The position of the spoon is set to conform to the curvature of the roof.

In Fig. 5-12 a jack combination of a rubber head, extension tube, and a base plate pushes out a crushed section of the roof panel. A wooden block is placed under the base plate to distribute the pressure over the floor.

Figures 5-13, 5-14, and 5-15 show how the jack pushes from different locations to square up a door pillar. Note the necessary wood-block supports and direction of force. Use diagonal measurements to determine accurate squaring.

In Fig. 5-16 this setup pulls the forward corner of the door frame down as indicated by the arrow. An extension tube and a toe

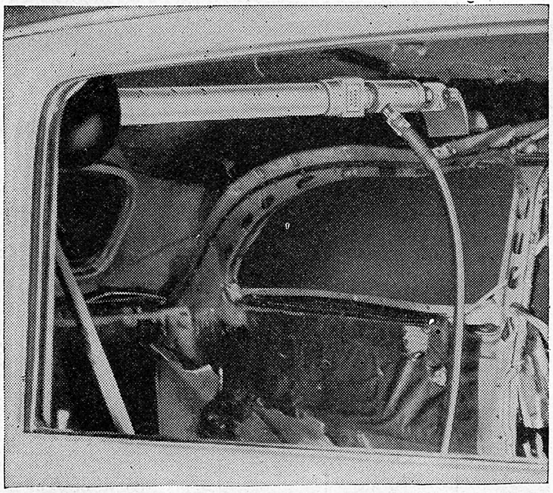

Fig. 5-10.

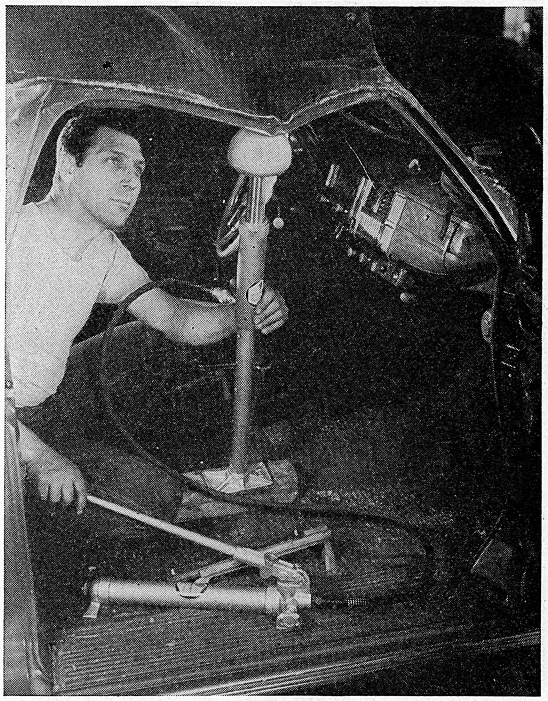

Fig. 5-12.

Fig. 5-11.

are used to support the head at the front door pillar.

Figure 5-17 shows a combination consisting of a rubber head, tube clamp head, clamp pin, 20-in. extension tube, and a clamp-end toe which is anchored beneath the frame. The wood block distributes the force over a greater portion of the floor.

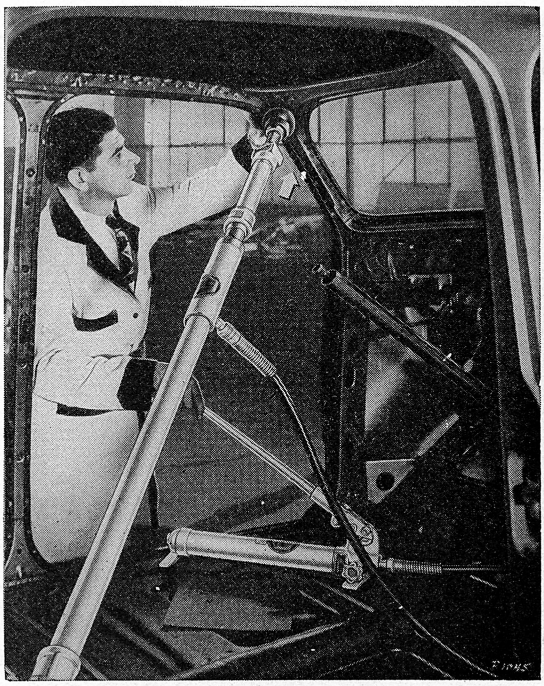

Fig. 5-13.

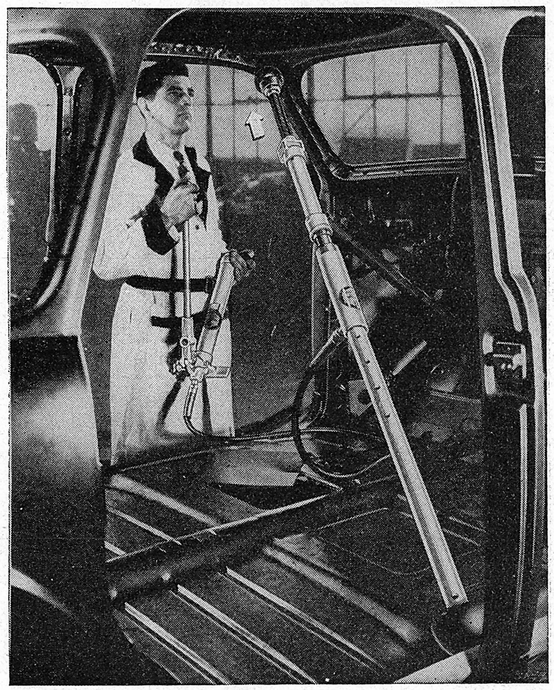

FIG. 5-14.

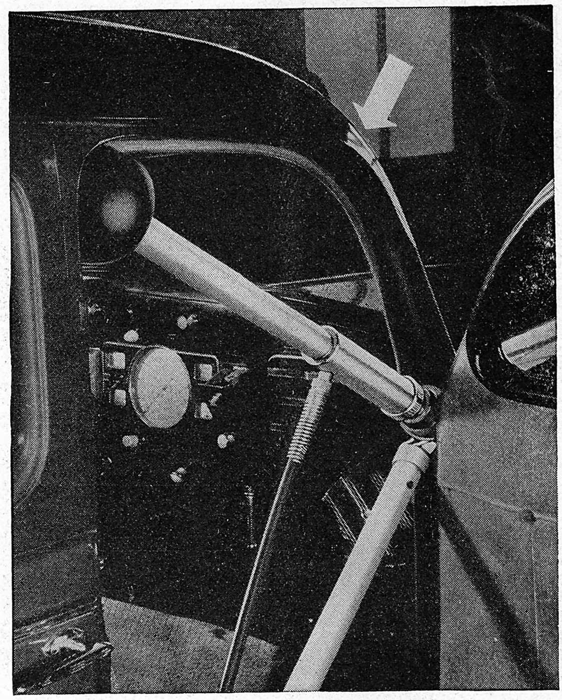

FIG. 5-16.

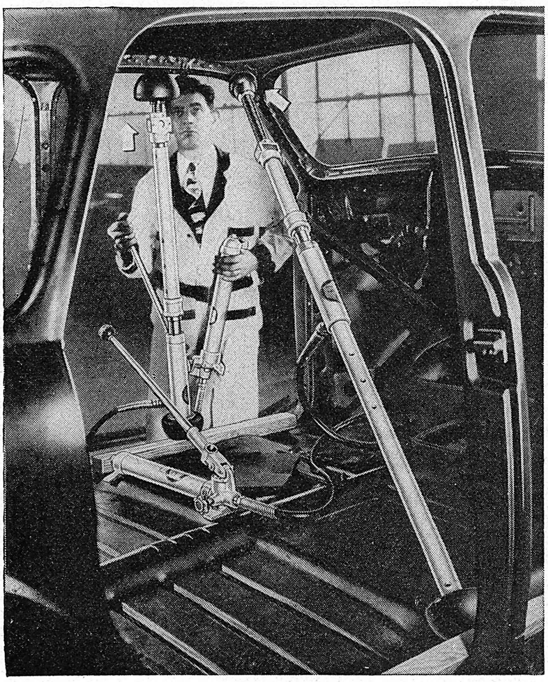

FIG. 5-15.

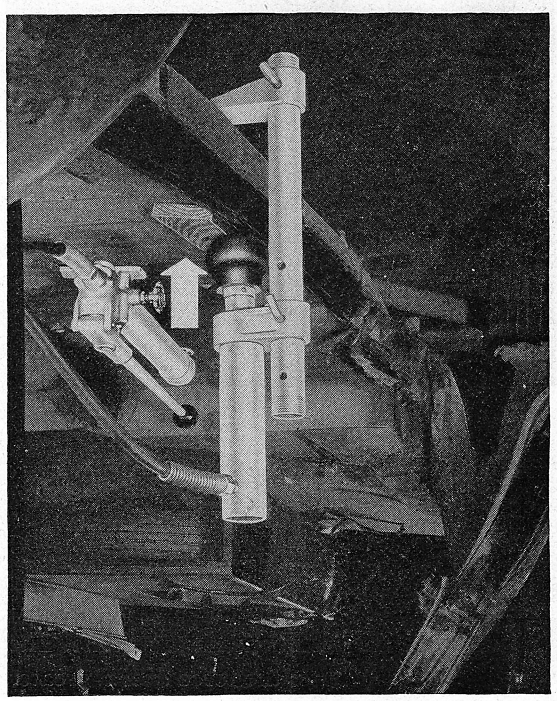

FIG. 5-17.

In Fig. 5-18 the spreader plunger toe and the spreader ram toe are used to push out the rear header structures and other pushed-in frame members. The sturdy toes of these attachments are anchored as shown.

Figure 5-19 shows a small hydraulic jack and wedgie slipped into tight-squeeze quarters.

In Fig. 5-20 two types of spreader toes are used to open up crushed sections. This combination is also used as a toe-lift jack.

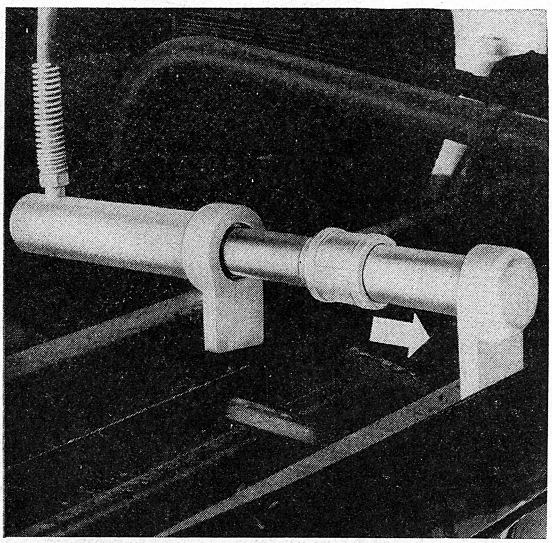

Fig. 5-18.

Fig. 5-19.

Figure 5-21 shows a combination used to realign curvatures of automobile doors. Wooden blocks are nailed to each end of the beam. Use the rubber head on the ram plunger to prevent damage to the upholstery on the door.

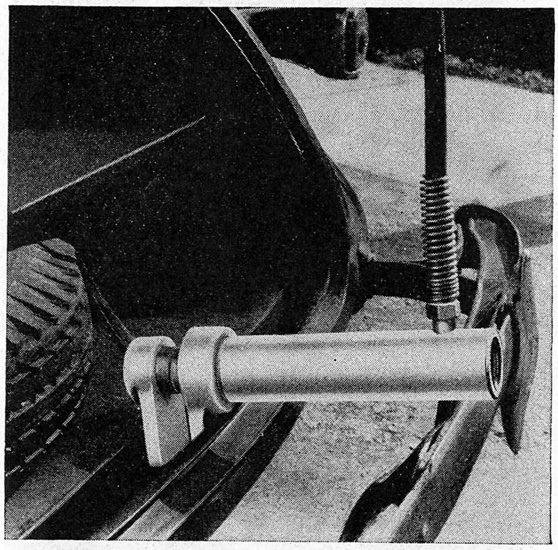

Fig. 5-20.

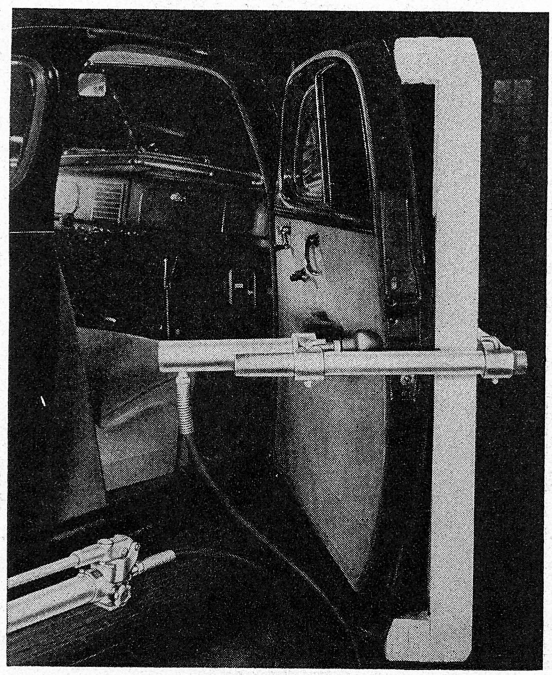

Fig. 5-21.

In Fig. 5-22 the adjustable body spoon and the clamp-end toe are used in this straightening application. Because of a sturdy, thin construction, the spoon easily fits into narrow of tight spots.

In Fig. 5-23 a single 2 by 4-in. beam rests against the top and bottom of the post to hold the combination and act as the base for curving the doorpost. The head does not harm the paint. The beam shown in Fig. 5-21 may also be used in this operation.

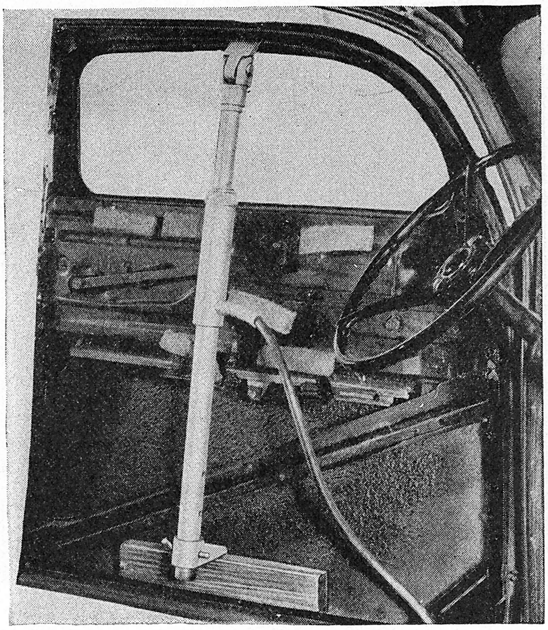

FIG. 5-22.

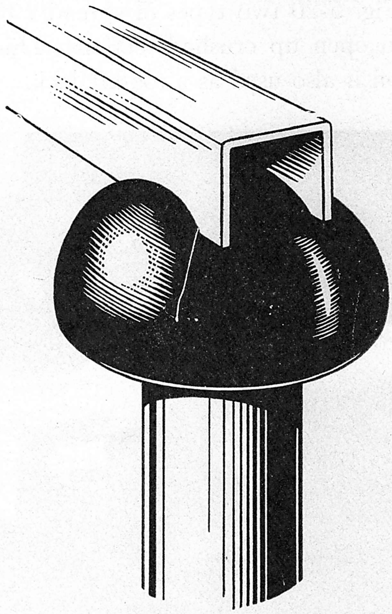

FIG. 5-24.

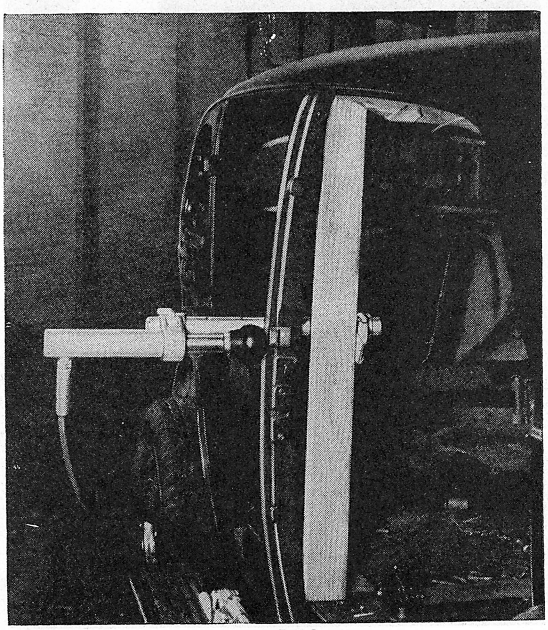

FIG. 5-23.

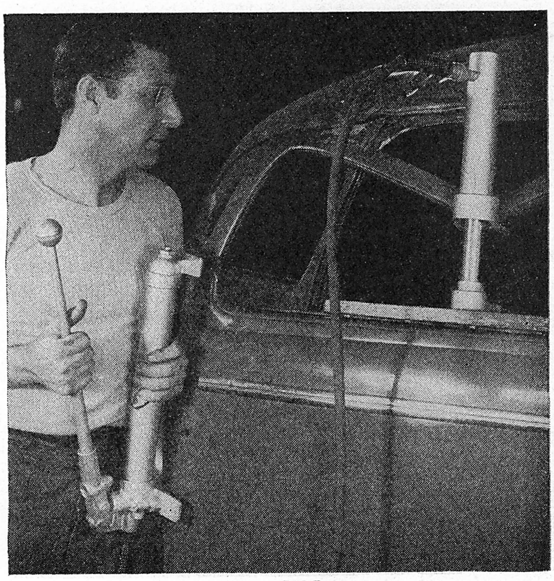

FIG. 5-25.

Figure 5-24 shows how the rubber head conforms to the structure or object it strikes. Heads are made to withstand more than average wear.

The smashed window frame shown in Fig. 5-25 is being restored to its original shape with a hydraulic-jack combination consisting of the two toes. A wooden block spreads the hydraulic force over the sill. Note how this user checks the job as he operates the pump.

Smashed or bent windshield frames are easily repaired with the combination shown in Fig. 5-26. The arrow shows the direction of the hydraulic force. A slip-lock extension is used for speedy adjustments.

In Fig. 5-27 a small hydraulic jack is employed to force out a crushed fender.

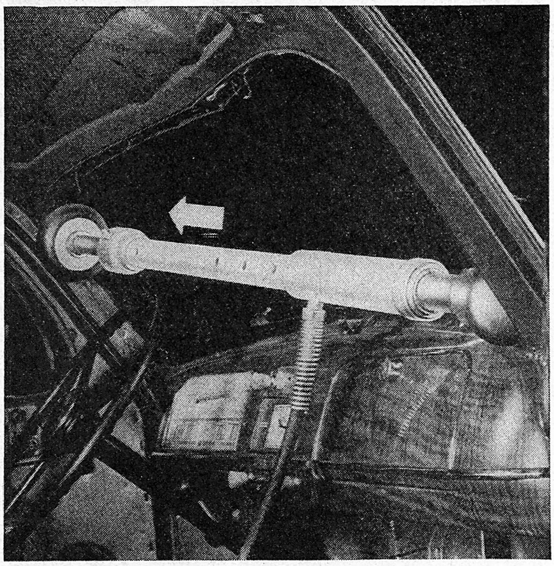

FIG. 5-26.

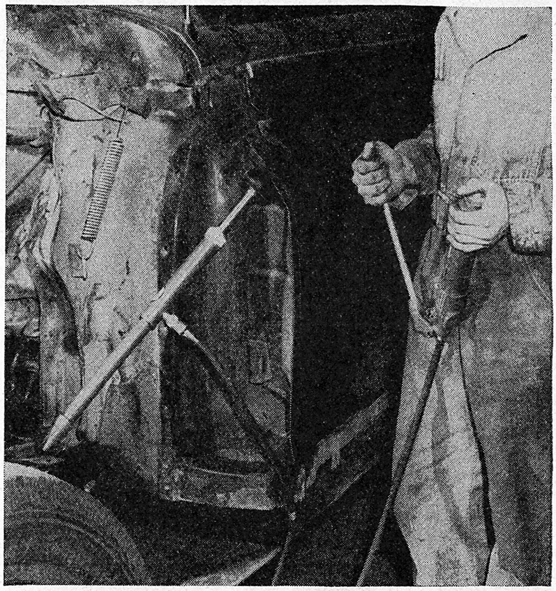

FIG. 5-28.

FIG. 5-27.

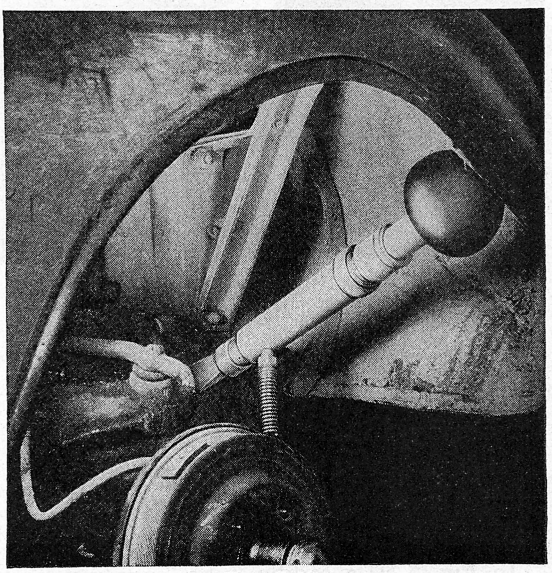

FIG. 5-29.

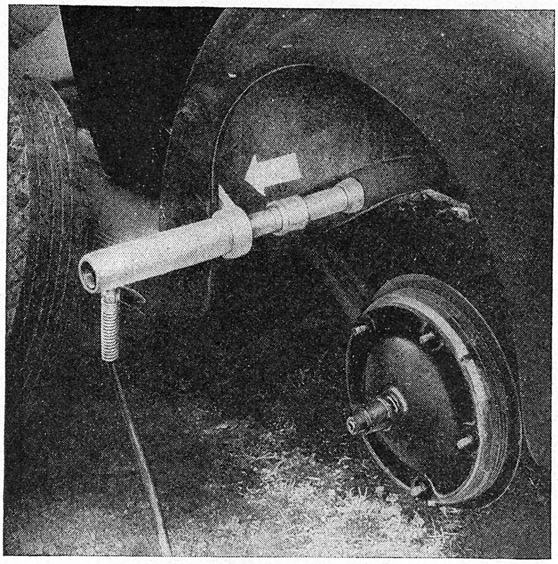

Fig. 5-30.

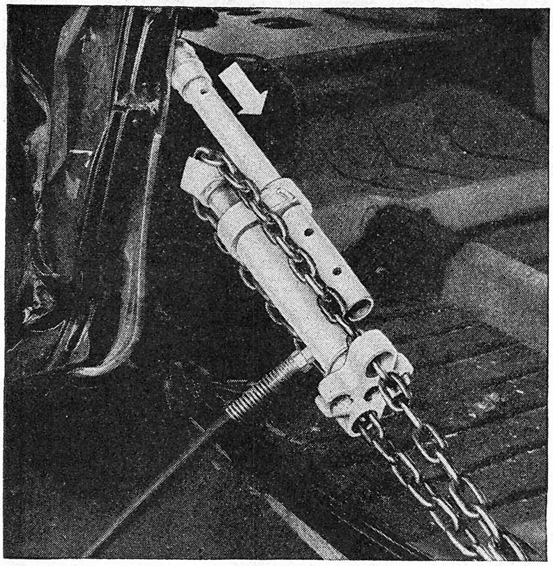

Fig. 5-31.

In Fig. 5-28 the small unit is used to push out the door structure, with the base of the jack resting tight against the car frame.

In Fig. 5-29 the fender is moved out by using a combination of the toe, coupling, small extension, and rubber head.

In Fig. 5-30 a saddle, tube, coupling, and

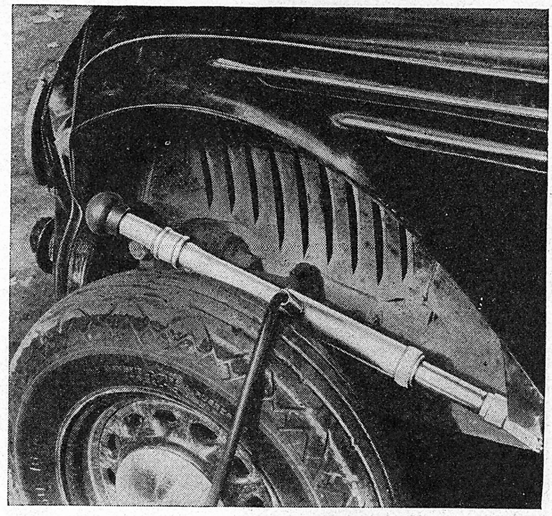

Fig. 5-32.

spreader toe are employed for this operation. When fenders are badly crushed against the body, the tube and coupling can be removed so that the toe will slip behind the crushed fender.

In Fig. 5-31 a combination setup is used for pulling. The adjustable body spoon is hooked behind the rear doorpost, while the chain is anchored to the frame. The arrow indicates direction of pull.

In Fig. 5-32 the ram is anchored with a wedge-type head, which is placed against a body bracket or some support along the frame member. Two extensions are used to give the needed length.

Questions

1. What are the main elements of a hydraulic-body-jack assembly?
2. Can a turret top be straightened in one application of a hydraulic body jack?
3. To what types of jobs is the cowl spoon best fitted?
4. What is a hydraulic "wedgie"?
5. What is a toe-lift jack?
6. Can smashed window frames be straightened with hydraulic body jacks?
7. Are body jacks ever used for a pulling operation? If so, give several examples.

CHAPTER 6

Body-panel Straightening

Straightening Fenders

Nearly 75 per cent of the sheet-metal work in a body shop is repairing fenders. Fender design has changed greatly on the new models and therefore presents new problems in straightening.

Fender skirts have large curved surfaces resembling door panels and must be repaired in the same way. High-crown sections are not as difficult because a slight stretch in the metal is not noticeable.

The apprentice body mechanic usually gets his first experience in sheet-metal straightening on fender repair and learns fundamentals that are later used on the more difficult jobs of sheet-metal straightening.

The following example was selected because it presents almost all operations encountered in fender straightening. By carefully studying this procedure, the beginner can gain a wealth of knowledge of fundamentals.

Tools and Equipment

Welding outfit; No. 1 tip; No. 3 tip; disk sander; safety goggles; Body and Fender Machine; dinging hammer; pick hammer; all-purpose dolly; bumping dolly; dinging spoon; body file; wire brush; thin caulking iron; ball-peen hammer; Vise-Grip wrench; scratch awl; aviation snips; soldering kit.

Materials

$\frac{3}{32}$-in. mild-steel welding rods; 20-gauge cold-rolled sheet metal; No. 36 open-coat disk; No. 36 closed-coat disk; body solder; asbestos paper.

Procedure

1. Study Figs. 6-1 and 6-2 very carefully.

a. Notice the following damages:
Long sharp crease above the damage along the entire fender (*A*); sharp kink in the fender flange (*B*); torn area at the rear of the skirt (*C*); small dent from the fender grille to the headlight flange. The entire skirt is damaged and badly stretched; the fender flange at the rear is damaged and stretched.

2. Use a bumping dolly to bump out the dent between the headlight flange and the fender grille.

3. Use a bumping dolly to bump out the damage along line *A*, beginning at the front (Fig. 6-1).

4. Use a dinging spoon and a ball-peen hammer to flatten the sharp crease in the crown above line *A*, Fig. 6-2.

5. Use a dinging hammer and an all-purpose dolly to smooth the area between line *A* and the fender-flange damage *B*, Fig. 6-1.

6. Straighten the fender-flange at *B*, Fig. 6-1.

7. Heat the damaged area to a cherry red; then, with a thin caulking iron, drive the flange out to make it accessible to the all-purpose dolly.

8. Reheat the area and, with the all-purpose dolly and a dinging hammer, straighten the area to its original shape.

9. Rough out the area between *B* and *C* with an all-purpose dolly and a peening hammer (Fig. 6-1).

10. Trim the area around the torn damage *C*, Fig. 6-1, with aviation snips, and install a patch (see section on Installing a Fender Patch, p. 63).

11. Shrink all the stretched areas between *B* and *C*, Fig. 6-3. (See also section on Shrinking Sheet Metal, p. 18).

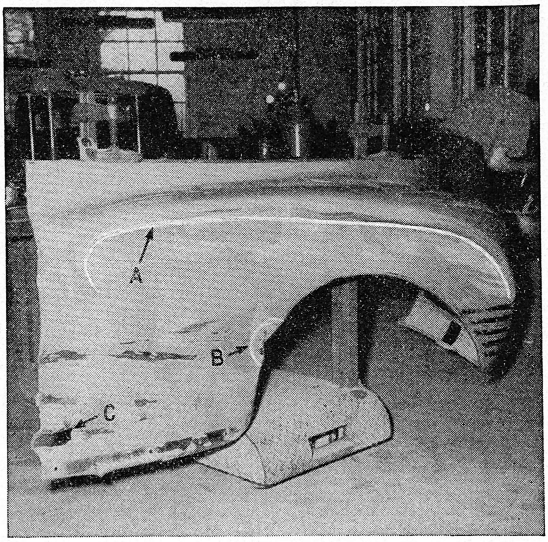

Fig. 6-1.

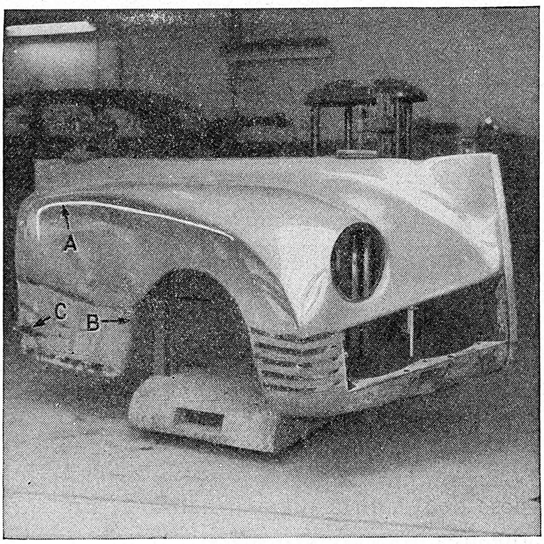

Fig. 6-2.

12. Use a Body and Fender Machine to smooth the entire fender (see section on Using Body and Fender Machine, p. 38).

13. Use a No. 36 open-coat disk to remove the paint from the damaged area.

14. Pick and file downward to the fender flange, beginning at the front of the fender and working toward the rear of the fender, maintaining the correct contour.

15. Pick and file toward *B*, Fig. 6-1, beginning at the lower rear end of the fender skirt, then downward to the lower edge of the skirt.

16. Straighten the fender flange on the rear of the fender.

17. Solder the fender flange.

a. When soldering the edge, direct the

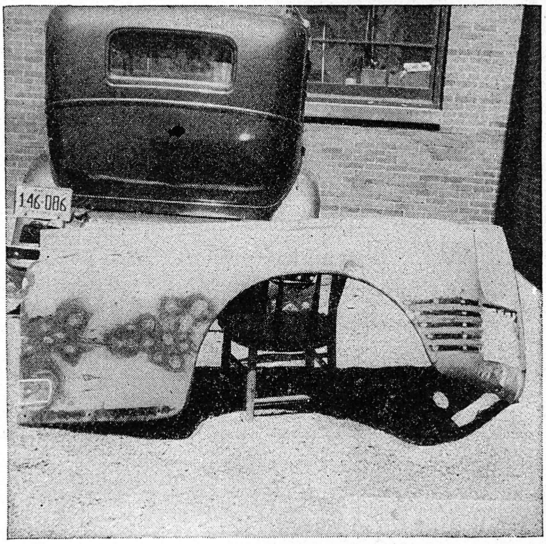

Fig. 6-3.

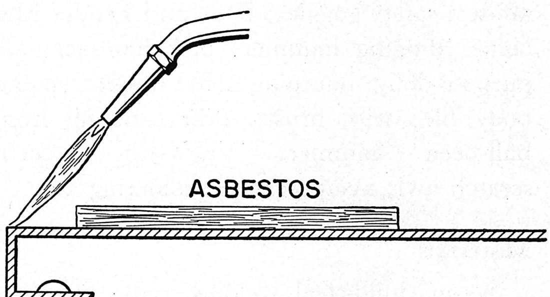

Fig. 6-4.

flame away from the panel to keep it from expanding.

b. The fender skirt panel should be covered with wet asbestos paper during the soldering operation (Fig. 6-4).

c. When filing the solder on the edge of a panel, file from the outer edge toward the center of the panel to maintain a level surface without overfiling the edge.

18. Shape the edge of the fender with a file.

19. Use a No. 36 closed-coat disk to sand the repaired area, but do not sand over the solder.

Figure 6-5 shows the fender after sanding. Figure 6-6 shows the fender after painting.

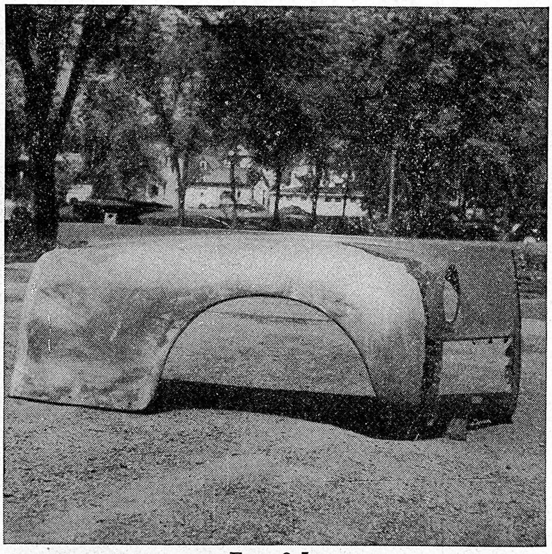

FIG. 6-5.

FIG. 6-6.

Installing a Fender Patch

When fenders are badly rusted or have had a previous damage, the metal burnt, a poor weld made, or the weld has been made too thick, it is more economical to install a patch than to repair the damaged area, and the result will be a better job.

Tools and Equipment

Welding outfit; No. 1 tip; No. 4 tip; Porto-Power; disk sander; safety goggles; aviation snips; dinging hammer; all-purpose dolly; welding clamps; wire brush; body file; scratch awl; hack saw; soldering kit.

Materials

1/16-in. mild-steel welding rod; 20-gauge cold-rolled sheet metal; body solder; No. 36 closed disk.

Procedure

1. Cut out the rusted or poorly welded part of the fender with aviation snips and a hack saw (Fig. 6-7).

2. Cut a sheet-metal patch large enough to extend ½ in. beyond the edges of the section which was removed and 1½ in. below the edge of the fender (Fig. 6-8).

3. Curve the patch to the fender contour.

a. Place the hydraulic jack under the nose of the fender to hold it in alignment.

4. Place the patch on top of the fender opening, and mark with the scratch awl from underneath (Fig. 6-8).

5. With aviation snips, trim the patch along the lines made with the scratch awl.

6. Fit the patch in the opening (Fig. 6-9).

a. Hold the patch in place with welding clamps.

7. Tack-weld the patch.

a. Tack-weld the upper corners (*A,* Fig. 6-10).

b. Tack-weld the lower corners (*B,* Fig. 6-10).

8. Tack-weld at mid-points between the corner welds (*A,B,C,* Fig. 6-11).

a. If necessary, make more tack welds, spacing the welds 1 in. apart. (*D,* Fig. 6-11).

b. Retain the proper contour of the fender during the tacking process, using the hammer and dolly.

9. Run a continuous weld around the patch (*A,* Fig. 6-12).

10. Using a scratch awl, mark the over-

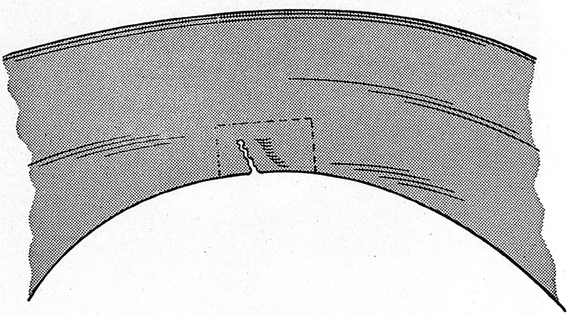

Fig. 6-7.

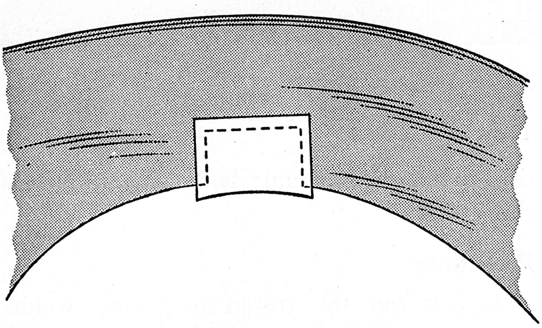

Fig. 6-8.

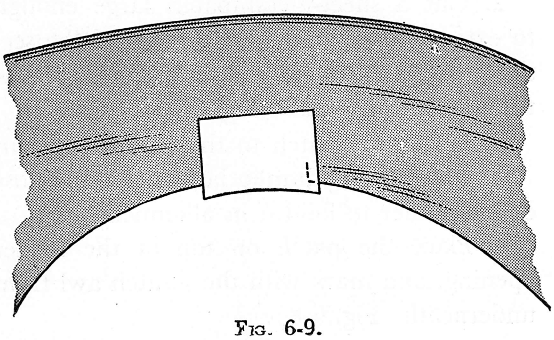

Fig. 6-9.

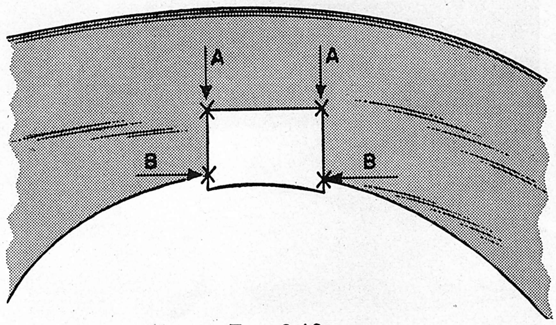

Fig. 6-10.

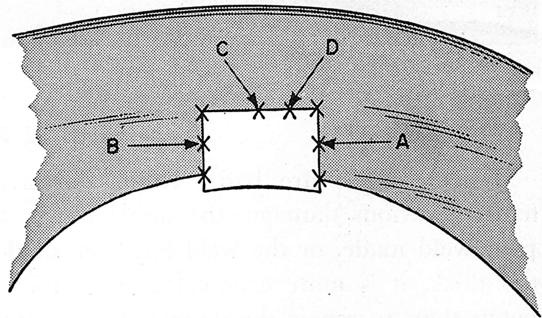

Fig. 6-11.

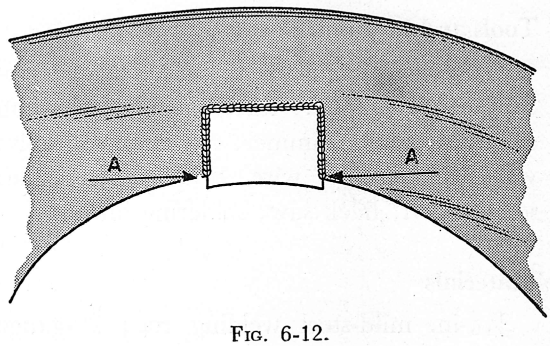

Fig. 6-12.

hanging part of the patch along the line of the fender edge (*A*, Fig. 6-13).

11. Shape the overhanging part of the patch to make the fender flange, using the hammer and dolly (*A*, Fig. 6-14).

12. Weld the patch to the fender flange.

13. Trim the excess part of the patch along the fender flange.

14. Forge the entire weld, maintaining the proper contour of the fender (Fig. 6-15).

15. Smooth the patch where necessary.

16. Straighten by picking and filing where necessary.

17. Solder where necessary.

18. File the solder to fender contour.

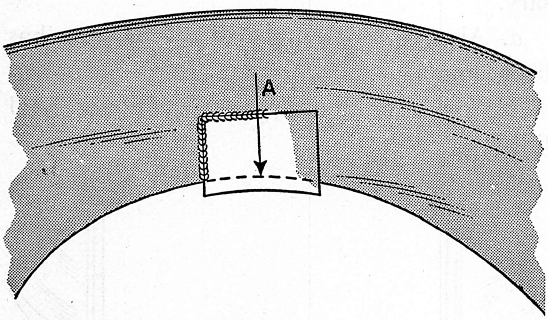

FIG. 6-13.

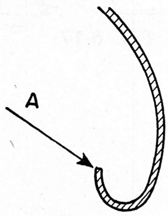

FIG. 6-14.

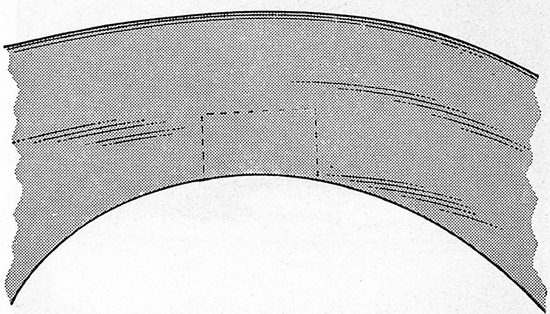

FIG. 6-15.

Straightening Lower Trunk Panel

There are two types of lower trunk panels: single panel and double panel. The single panel is straightened in the usual manner. The double panel is quite different. Straightening it involves cutting away part of the inner panel to make the outer panel accessible from the back.

Figure 6-16 shows a typical damage of a lower trunk panel. Fig. 6-17 shows a cutaway view: *A*, an outer panel; *B*, an inner panel. Damage is repaired by the following procedure.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip: disk sander; safety goggles; bumping hammer; pick hammer; dinging hammer; all-purpose dolly; welding clamps; long-handled dolly; body file; soldering kit.

Materials

1/16-in. mild-steel welding rod; No. 36 open-coat disk and No. 36 closed-coat disk; body solder.

Procedure

1. Clean out the trunk, and take all precautions against fire.

2. Cut the inner panel in two places, as shown in the phantom view (*A*, Fig. 6-18).

CAUTION: Direct the flame of the cutting torch away from the gas tank.

3. Bend back the pieces cut in the inner panel to gain access to the outer panel.

4. Roughen out the outer panel with a bumping hammer.

5. Smooth the outer panel with a dinging hammer and an all-purpose dolly.

6. Remove the paint from the outer panel, using a No. 36 open-coat disk.

7. Finish the panel straightening by picking and filing.

8. Sand the panel, using a No. 36 closed-coat disk.

9. Weld the inner panel in place.

a. Use welding clamps to hold the panel in place while welding.

10. Solder the outer panel where necessary.

a. Always solder *after* all the welding has been done.

11. Smooth the solder, and file for final finish.

Fig. 6-16.

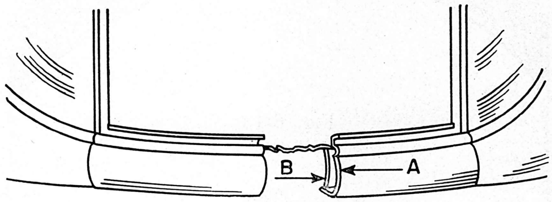

Fig. 6-17.

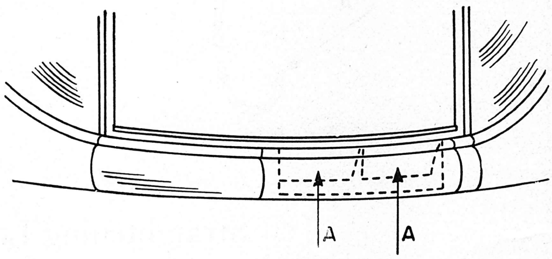

Fig. 6-18.

Straightening Rocker Panels

Analyze rocker-panel damages very carefully. The extent of the damage is usually more than appears on the outer panel. The inner panels may be pushed in, and repair of the outer panel only will not correct the damage, because the distance from the outer panel to the floor pan may have been shortened. When the damage is extensive, estimate closely to determine the cost of repair compared to that of replacement. Determine also the easiest way to get at the damage.

Most rocker-panel damages can be repaired by the following procedure.

Tools and Equipment

Welding outfit; No. 1 tip; hack saw; ¼-in. electric drill; $\frac{3}{16}$-in. twist drill; disk sander; safety goggles; soldering kit; dinging hammer; pick hammer; all-purpose dolly; flat dolly; body file; vise; Vise-Grip wrench; caulking irons.

Materials

$\frac{1}{16}$-in. mild-steel welding rod; $\frac{1}{16}$-in. bronze welding rod; body solder; No. 36 open-coat disk; No. 36 closed-coat disk; brazing flux; primer.

Procedure

1. Remove the rocker-panel molding, clips, and step plate.

2. Cut the outer panel with a hack saw (*A*, Fig. 6-19).

a. Do not cut the inner panel (see cross cut *B*, Fig. 6-20).

3. Drill spot welds at the top edge of the outer panel (*B*, Fig. 6-19).

a. Location of the spot welds shown at *B*, Fig. 6-20.

4. Work the panel in and out to break the spot welds at the bottom edge of the panel (*C*, Fig. 6-19, and *C*, Fig. 6-20).

5. Clamp the panel in a vise, and straighten with hammer and dolly.

a. A caulking iron can be clamped in a vise and used as a dolly to straighten sharp corners.

b. Areas at *D* and *E*, Fig. 6-20, may have on Sheet Metal Shrinking, p. 18).

6. Check the straightened panel for fit.

a. If the outer panel has the correct shape but does not fit the inner panel, the inner panel must also be straightened.

b. The inner panel is easily accessible when the outer panel is removed.

c. The inner panel does not need filing but must be dinged out to the proper shape.

7. Smooth the spot welds on the lower edge of the inner panel with a No. 36 closed-coat disk (*C*, Fig. 6-19, and *C*, Fig. 6-20).

8. Position the outer panel, and hold it in place with Vise-Grip wrench on the bottom edge.

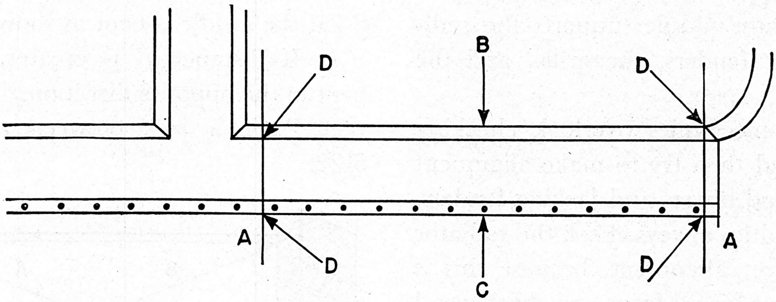

Fig. 6-19.

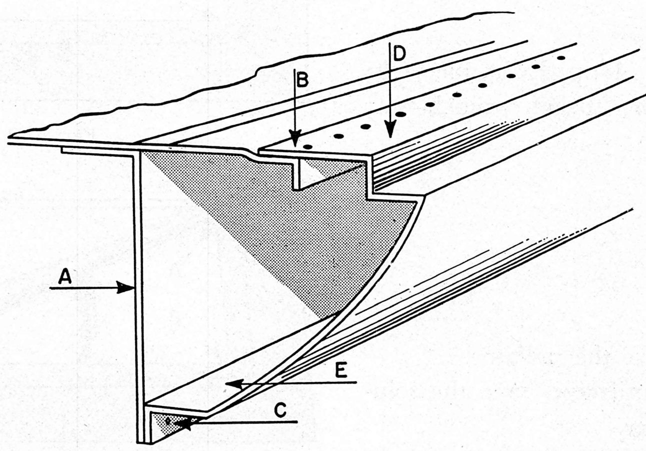

Fig. 6-20.

9. Tack-weld the four corners of the outer panel (*D*, Fig. 6-19).

10. Spot-weld the upper edge of the outer panel to the floor pan (*B*, Fig. 6-19, and *B*, Fig. 6-20). See section on Welding Sheet Metal, p. 13).

11. Tack-weld the lower edge of the panel (*C*, Fig. 6-19, and *C*, Fig. 6-20).

12. Weld the panel at both ends with a flat weld.

13. Finish welding at the top and bottom edges of the panel, alternating the welds and dividing them equally on both sides of the center.

14. Smooth the welds at both ends of the panel and solder where necessary.

15. Smooth the spot-welds on the top edge of the panel with a No. 36 closed-coat disk.

16. Prime the bare metal (see section on Painting, p. 110).

a. All bare metal must be primed to prevent rusting.

17. Replace the step plate and the molding.

a. To avoid masking, the molding and step plate may be left off until the panel is painted.

Straightening and Aligning Radiator Saddle

On most front-end damage the radiator saddle is involved. Misalignment at this point makes alignment of the hood impossible. The radiator saddle supports the radiator, both front fenders, the grille, and the hood.

Many body mechanics overlook checking at this point and then try to make alignment by changing hood hinges and jacking fenders. To avoid difficulties always check the radiator saddle for correct alignment, because this is the starting point for all front-end sheet-metal alignment.

Tools and Equipment

Welding outfit; No. 4 tip; hydraulic jack; short measuring tram; socket wrench set; screw drivers.

Materials

None.

Procedure

1. Drain and remove the radiator.

a. If it contains antifreeze, save the solution in a clean container.

2. Check the saddle by measuring from corresponding points the distance *A* and *B*, as in Fig. 6-21.

a. If distance *A* is greater than *B*, Fig. 6-21, the saddle is bent as shown in Fig. 6-22.

b. If distance *B* is greater, the saddle is bent in the opposite direction.

3. Place a jack between *A* and *B*, Fig. 6-22.

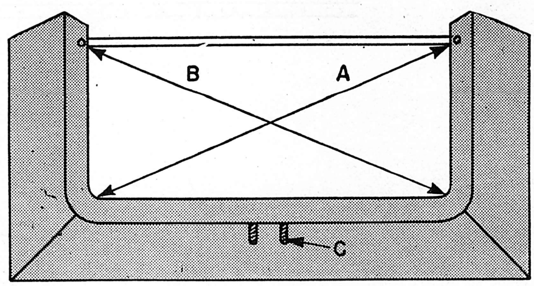

FIG. 6-21.

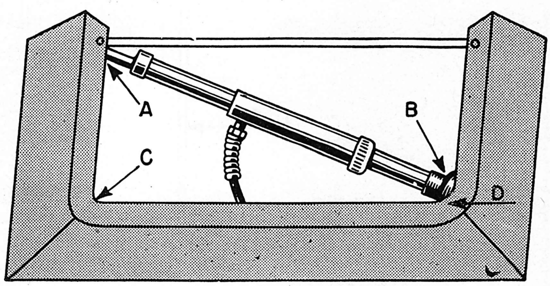

FIG. 6-22.

4. Heat the edges of the radiator saddle at points *C* and *D*, Fig. 6-22.

5. If distance *A* is 2 in. longer than *B*, Fig. 6-21, extend the jack to push point *A*, Fig. 6-22, over 1 in. into alignment.

6. After saddle edges have cooled, remove the jack and cross-check.

a. Repeat the operation until the saddle is straightened.

7. Measure the distance from the upper ends of the radiator saddle to the cowl (Fig. 6-23).

8. Equalize the distance on both sides by loosening the saddle to the fender bolts and using the jack.

9. Close the hood and check alignment.

a. If the hood is too close to either side, loosen the center bolts at *C*, Fig. 6-21, and move the saddle to obtain correct alignment.

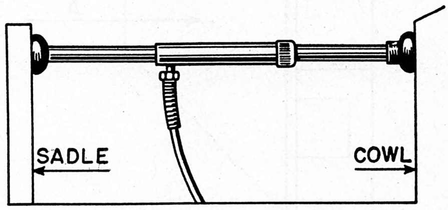

Fig. 6-23.

Straightening a Lower Cowl Panel

Lower cowl-panel damages occur when a fender is damaged at the front and pushes the lower cowl panel inward or when broken or stretched door straps allow the door to open too far and crease the lower cowl panel. Some damages can be repaired without door removal, while others involve door removal.

The following procedure is used to repair a damage caused by a broken door strap. The panel was creased by the door's opening too far (*A*, Fig. 6-25).

Tools and Equipment

Welding outfit; No. 2 tip; socket wrenches; screw drivers; cold chisel; ball-peen hammer; dinging hammer; pick hammer; toe dolly; body file; disk sander; safety goggles; soldering kit.

Materials

1/16-in. mild-steel welding rod; body solder; No. 36 open-coat disk; No. 36 closed-coat disk.

Procedure

1. Remove the kick pad (*A*, Fig. 6-24).

a. Some kick pads are fastened with sheet-metal screws, while others are held in place with a retaining channel.

b. Kick pads with a retaining strip, or channel, are removed by bulging the kick pad at the top toward the inside of the car and slipping it from the channel (*C*, Fig. 6-24).

2. Remove the door check strap at the doorpost (*B*, Fig. 6-25).

a. Loop a 6-in. length of welding rod through the door strap to keep it from falling into the door.

b. Some door straps are fastened with a screw; others are fastened with a rivet. Cut the rivet with a chisel and punch out.

3. Remove the door.

a. On some cars the windlace retaining channel (*B*, Fig. 6-24) must first be removed to get at the hinge screws (*D*, Fig. 6-24).

b. Some hinges have a screw on the inside of the hinge supporting box. Remove this screw first (*E*, Fig. 6-24). See cross section.

4. Cut the inside brace, when necessary, along line *A*, Fig. 6-26, and bend the brace down to the floorboard to gain access to the damage from the inside.

5. Bump out damage from the inside.

a. Shrink where necessary (see section on Shrinking Sheet Metal, p. 18).

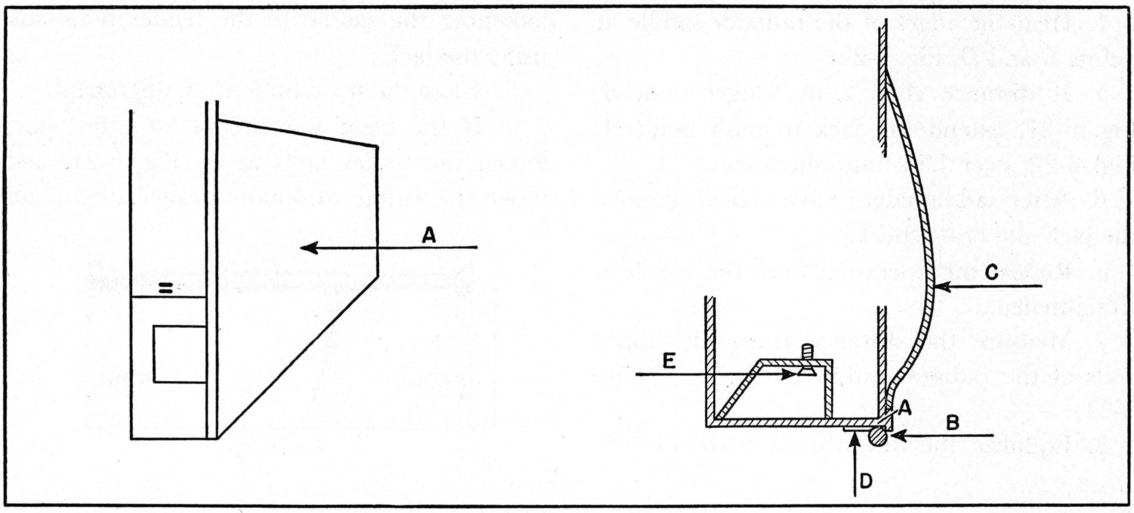

FIG. 6-24.

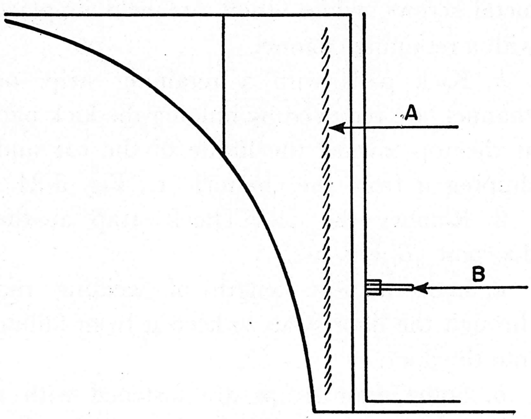

FIG. 6-25.

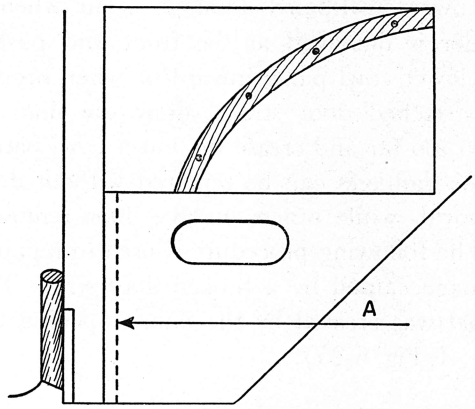

FIG. 6-26.

6. Remove paint from the damaged area with a No. 36 open-coat disk.

7. Pick and file, finishing with a No. 36 closed-coat disk.

a. When filing and grinding, be extremely careful not to damage the fender.

8. Solder small areas that could not be reached for straightening.

9. Replace the inner brace, and weld.

a. Take all necessary precautions against fire.

10. For installing parts that were removed, reverse the removal procedure.

a. If care is not used to put hinges on the exact spot from which they were removed, the door will be out of alignment.

Straightening Upper Cowl Panel

Damage to the upper cowl panel usually occurs in collisions and rolled-over cars. If the hood opens while driving, it can cause considerable damage. Slight damages are easily repaired. If the damage is extensive, the body mechanic must estimate carefully to determine

whether repair or replacement is advisable. Often the dash is severely damaged and removal is necessary. This may involve so much time that repair is more costly than replacement.

Where replacement of any panel of the cowl assembly is contemplated, make sure the panel is available. Some manufacturers furnish each panel separately, while others do not. On some makes, the upper cowl panel is part of the top assembly.

Tools and Equipment

Welding outfit; No. 2 tip; socket wrenches; screw drivers; Porto-Power; dinging hammer; pick hammer; all-purpose dolly; flat dolly; body spoon; body file; soldering kit; disk sander; safety goggles.

Materials

Body solder; No. 36 open-coat disk; No. 36 closed-coat disk; primer.

Procedure

1. Remove the hood.

NOTE: Remove the hood from the hinges and not the hinges from the car.

a. When the damage has been caused by the hood's blowing open, the hinges are usually bent and must be replaced (see section on Adjusting Hood Hinges, p. 46).

2. Remove windshield glass.
3. Check under the cowl to determine if the heater, radio, or windshield-wiper motor must be removed.
4. Remove the windshield-wiper transmission from the cowl.
5. Remove the ventilator panel if necessary.
6. Jack up all low areas and rough out with hammer and dolly.

a. The hydraulic jack can be used as a dolly, while a low-crown spoon is used on the ridges for straightening.

7. Finish straightening by picking and filing.
8. Solder where necessary.
9. Prime bare sheet metal before installing parts that were removed.
10. For installing all parts that were removed, reverse removal procedure.

Straightening a Trunk Door

In some trunk doors the inner panels are entirely closed, while in others the inner panels are partially open. When an inner panel is of the open type, many damages can be repaired without cutting. On the closed type, cutting is usually necessary.

In all straightening, alignment is the main factor. A poorly aligned door spoils the whole job.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; disk sander; safety goggles; dinging hammer; pick hammer; all-purpose dolly; body file; Vise-Grip wrench; socket set; screw drivers; soldering kit.

Materials

No. 36 open-coat disk; No. 36 closed-coat disk; $\frac{3}{32}$-in. mild-steel welding rod; body solder.

Procedure

1. Study the damage at *A,* Fig. 6-27.
2. Remove the hardware on the door.
3. Remove the door.

4. Cut the inner panel along *A*, as shown in Fig. 6-28.

a. Do not cut beyond the line.

b. Cutting too close to the edge causes the door to lose shape during straightening, and difficulty will be encountered in aligning.

Figure 6-29 shows the inner door panel removed.

5. Remove deadening material.

6. Rough out the outer panel.

7. Remove the paint, with a No. 36 open-coat disk, by sanding lightly.

8. Pick and file the panel.

9. Solder edges where necessary.

10. Smooth the solder with a body file.

a. Always file from the outer edge toward the center of the panel.

NOTE: Do not use a sanding disk on body solder. Solder cuts more easily than steel, and low spots will result from sanding.

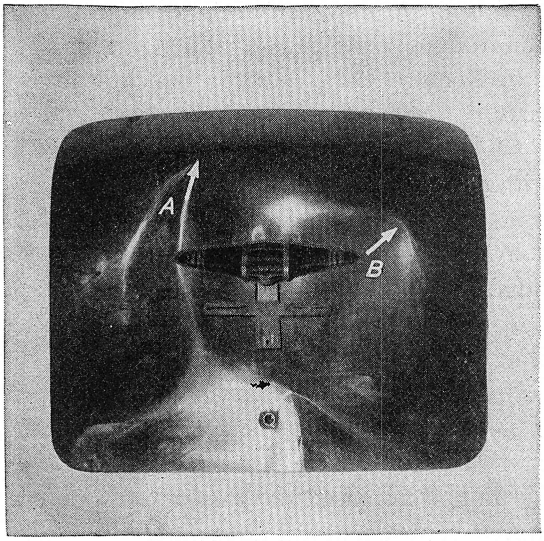

Fig. 6-27.

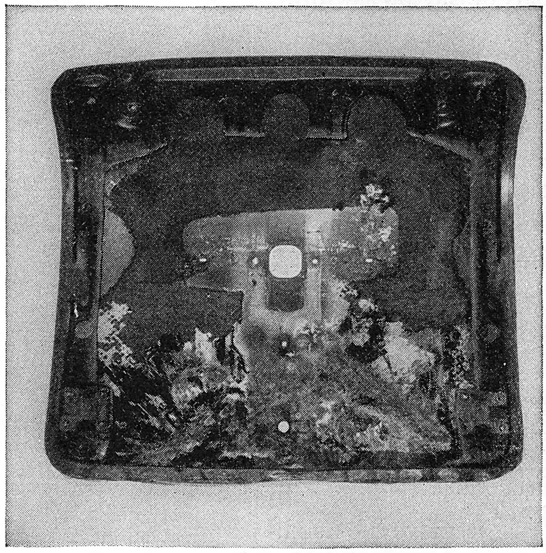

Fig. 6-29.

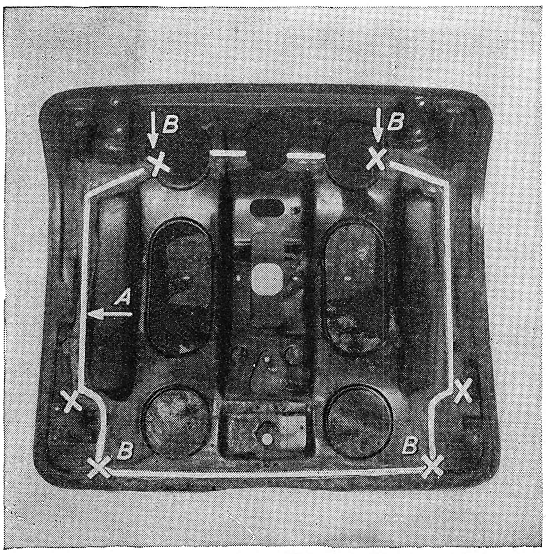

Fig. 6-28.

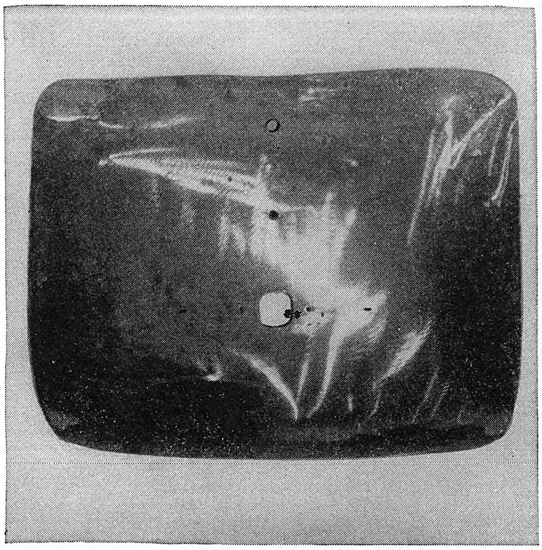

Fig. 6-30.

11. Replace deadening material.

12. Hang the door and check for alignment.

a. If the inner panel is damaged, it must be straightened to conform to the outer panel.

13. Tack-weld at corners as shown at *B*, Fig. 6-28.

a. If either lower corner is too high and the door does not close tightly, the tack weld at that corner must be opened and retacked with less gap.

14. Remove the door to finish welding.

a. Always weld the entire panel where it was cut. Do not skip any sections to save time.

b. Rotate welding procedure to avoid warpage.

c. If panels are close together, pour water into the door to prevent warping the outer panel, but do not let the water touch the inner panel.

15. Sand the outer panel with a No. 36 closed-coat disk (Fig. 6-30).

a. Avoid sanding the solder.

16. Replace the hardware.

Straightening a Door

Straightening a door is one of the more difficult body repair jobs. It requires good judgment in analyzing repair procedure and much patience in doing the work. Alignment is of utmost importance; the door must fit perfectly and the correct contour must be maintained. Windows and regulators must be in alignment in order that they may work freely.

The damaged door shown in Figs. 6-31 and 6-32 was sideswiped. The damage at *C* was severe, making a patch necessary. The hinge reinforcement plate was damaged so that a body jack could not be used. The upper part of the door was not damaged, and therefore repair was advisable.

This job provides nearly all the fundamental operations in door straightening.

The procedure is the same on all damages of a similar nature occurring around the edges of a door. Simple panel damages would not involve as much cutting of the inner panel as would more extensive damages.

Reference is made to minor damages in the

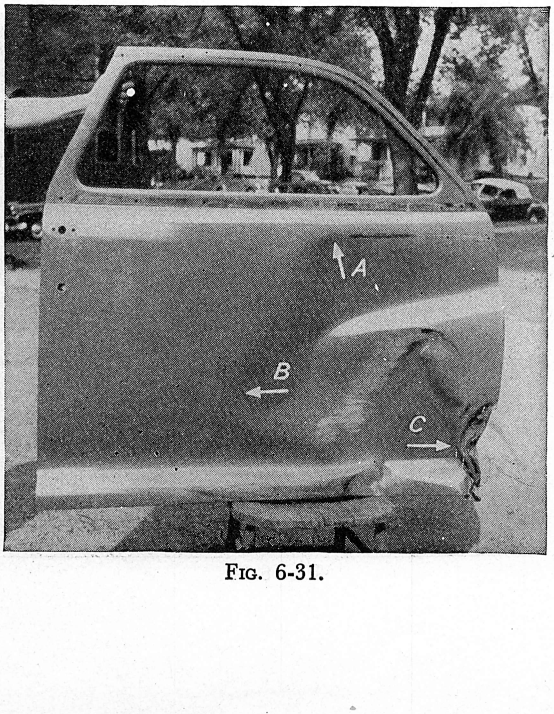

Fig. 6-31.

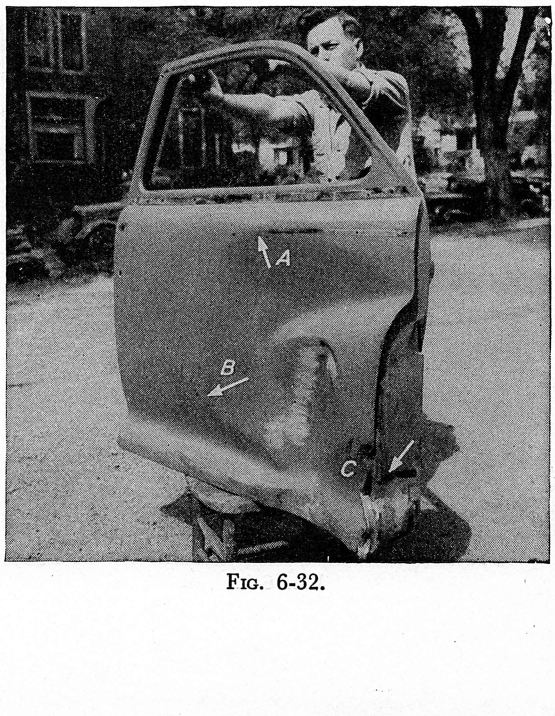

Fig. 6-32.

information topics of the following procedure.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; disk sander; safety goggles; hack saw; cold chisel; curved spoon; ball-peen hammer; dinging hammer; pick hammer; toe dolly; all-purpose dolly; body file; aviation snips; Vise-Grip wrench; soldering kit; socket wrenches; screw drivers.

Materials

20-gauge cold-rolled sheet metal 3/32-in. mild-steel welding rod; No. 36 open-coat disk; No. 36 closed-coat disk; body solder.

Procedure

1. Open the flanges on the bottom and forward side (Fig. 6-33) to gain access to the damage at *C,* Fig. 6-31.

a. Opening the flanges releases the strain on both panels (Fig. 6-33).

b. Removal of the damaged inner section *A* is made easier (Fig. 6-34).

2. Cut the edges of the inner door panel with a hack saw (Fig. 6-34).

a. Cutting the edges with a hack saw makes alignment easier when replacing the section.

3. Straighten the damaged section of the inner panel (Fig. 6-35).

a. The hinge-reinforcement plate is of heavy-gauge sheet metal (see cross section, Fig. 6-36).

b. Because of the thickness, this part is straightened on the anvil. Begin straightening at the bottom (Fig. 6-35).

c. Sometimes the hinge-reinforcement plate must be removed for straightening.

d. Removal is made by drilling the spot welds.

4. Straighten the flanges and weld the reinforcement plate where necessary.

a. Figure 6-37 shows the inner panel straightened.

5. Cut out the damage in the outer panel with aviation snips (Fig. 6-38).

6. Rough out the panel to proper contour.

7. Shape a sheet-metal patch to conform to the contour of the outer door panel (see cross section, Fig. 6-39).

8. Fit the patch to the cutaway section

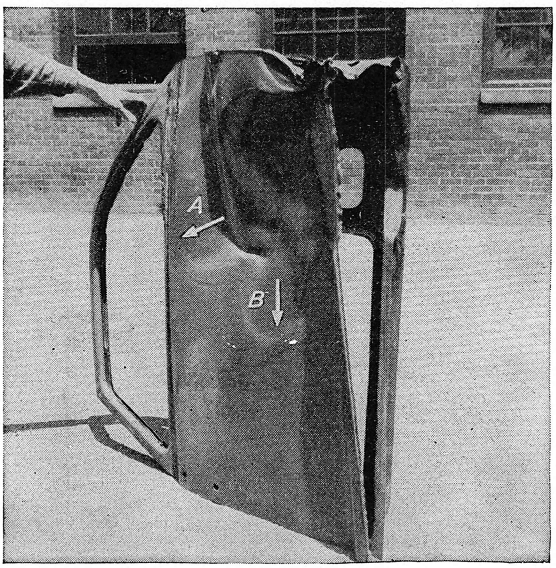

Fig. 6-33.

Fig. 6-34.

Fig. 6-35.

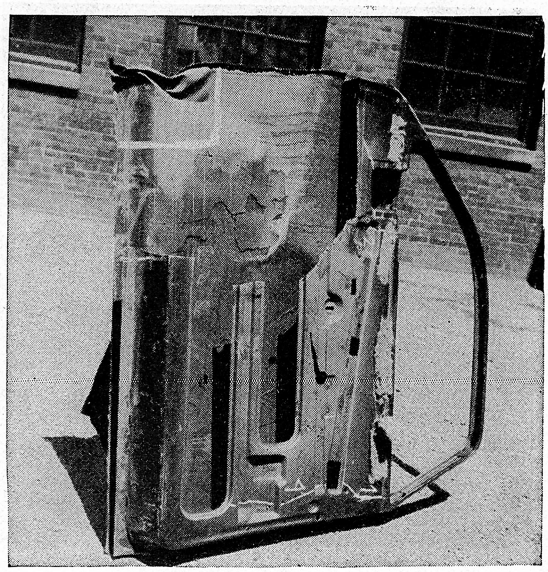

Fig. 6-38.

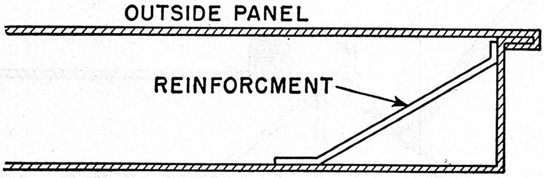

Fig. 6-36.

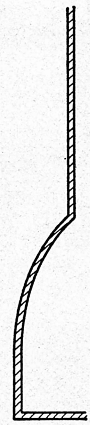

Fig. 6-39.

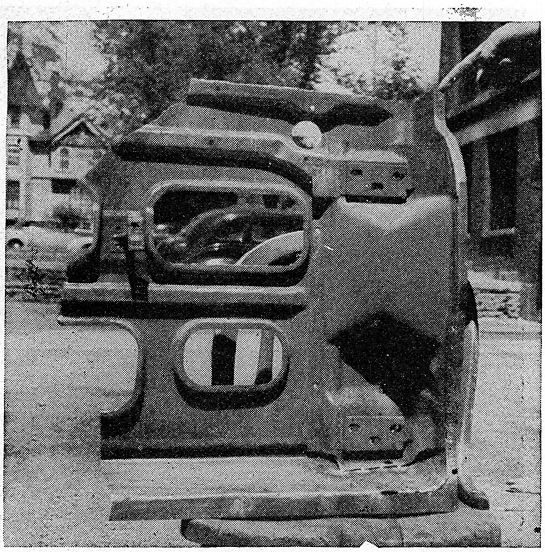

Fig. 6-37.

(see section on Installing a Fender Patch, p. 63).

9. Weld the patch in place, and forge the weld (Figs. 6-40 and 6-41).

10. Replace the section of the inner panel that was removed, and tack-weld as shown by arrows (Fig. 6-42).

a. Align and tack-weld the edges, holding the panel in place with a Vise-Grip wrench.

11. Flange the outer panel to the inner panel (see cross section, Fig. 6-43).

a. Note the position of the dolly and hammer.

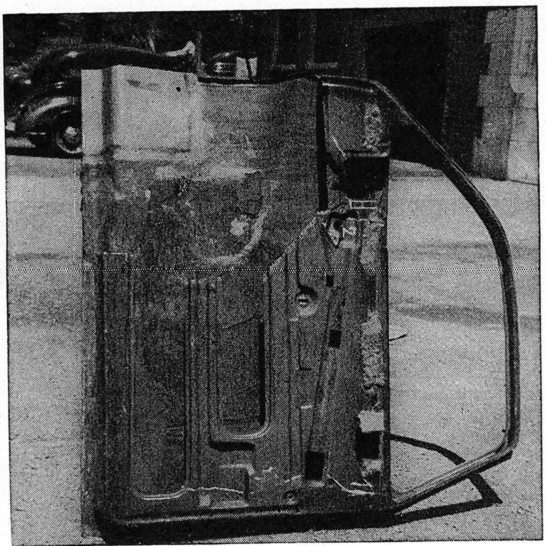

Fig. 6-40.

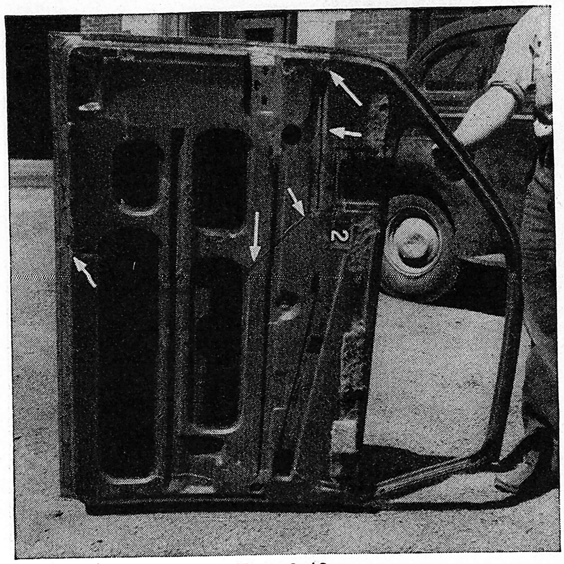

Fig. 6-42.

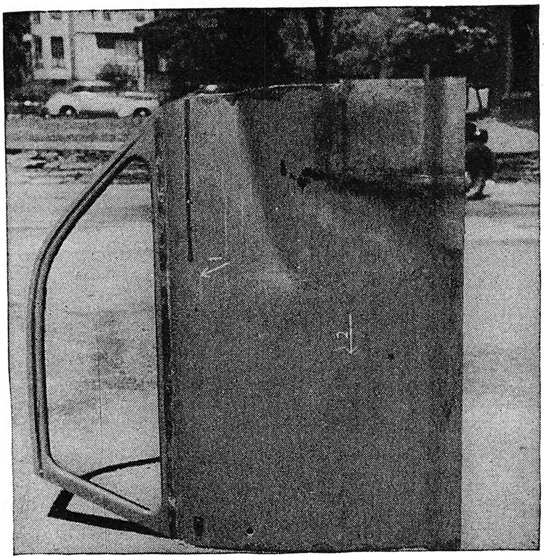

Fig. 6-41.

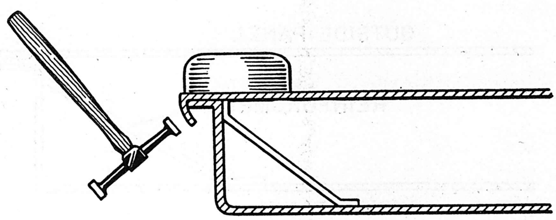

Fig. 6-43.

b. As a guide when flanging, place a line on the patch corresponding with the edge of the door.

c. Hold the edge of the dolly on the line while flanging.

12. Complete welding of the inner panel.

13. Remove section *B* of the inner panel, as shown in Fig. 6-44, by cutting at points 1 and 2 with a hack saw.

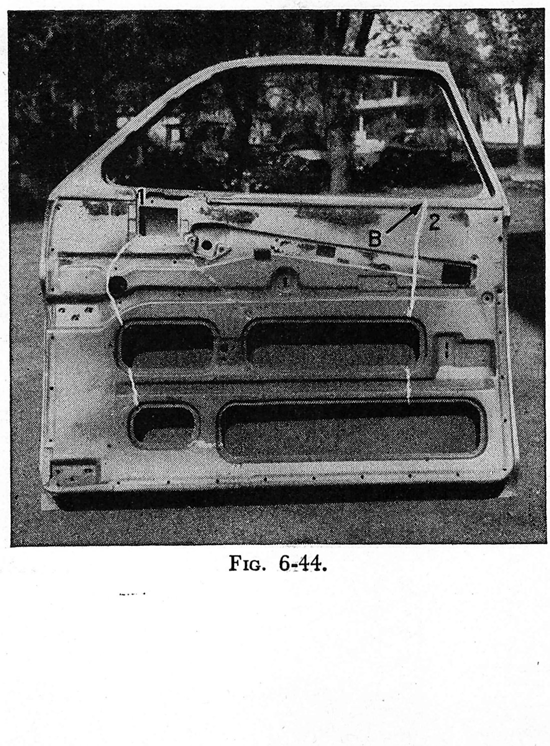

Fig. 6-44.

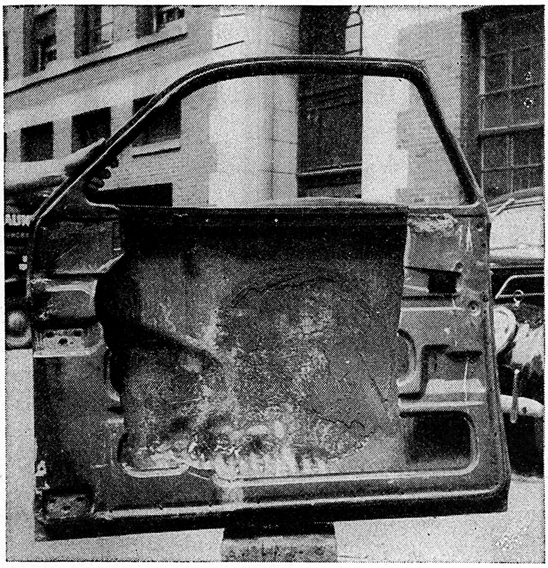

FIG. 6-45.

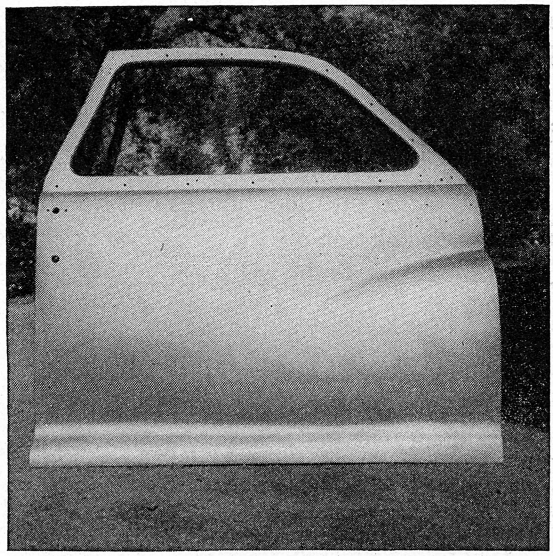

FIG. 6-47.

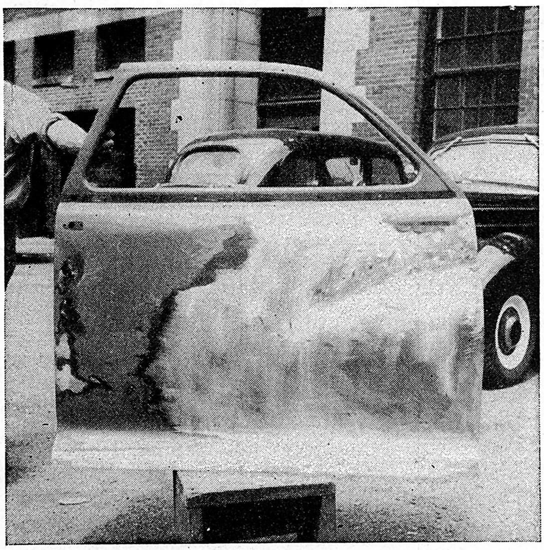

FIG. 6-46.

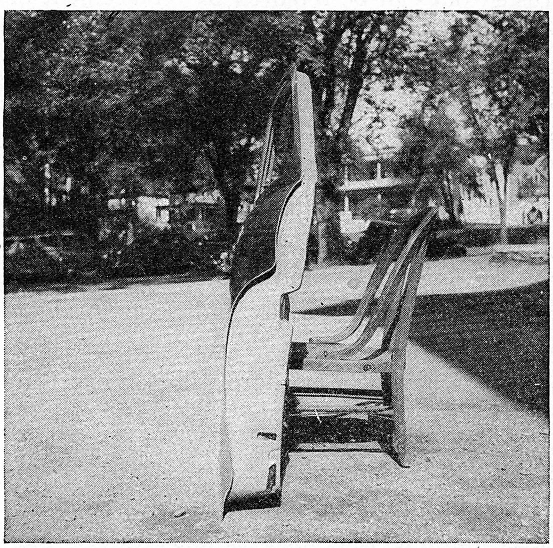

FIG. 6-48.

a. Section *B* is removed to gain access to the outer panel for final straightening.

NOTE: The front section of the inner panel must be in place to keep the door aligned (Fig. 6-45).

b. Be careful not to cut the hinge-reinforcement panel.

14. Remove the paint from the outer door panel with a No. 36 open-coat disk.

15. Finish straightening the outer door panel, soldering at the edges where necessary (see section on Applying Body Solder, p. 21).

16. Hang the door, and check for align-

ment before tack-welding the inner panel into place.

a. Keep the door closed while tack-welding the inner panel on all four corners.

b. If this is not done, the door may not fit.

17. Remove the door and finish welding the inner panel.

a. Always rotate the welds.

b. Figure 6-34 shows the inner panel *B* welded into place.

18. Sand the outer panel with a No. 36 closed-coat disk.

Figure 6-46 shows the door ready for painting.

Figures 6-47 and 6-48 show the job completed.

Straightening a Center Pillar

A center pillar is a hollow, boxlike structure built in two or three sections, one within the other. It carries the door and striker plate. It takes much abuse.

A pillar gets bent through damage and sometimes rusts out at the bottom. A bent pillar can be straightened, and one that has rusted out can be repaired by replacement of the rusted section.

If the damage is very severe, the entire pillar can be replaced at moderate cost.

Before starting work on a damaged pillar, a careful analysis should be made to determine whether the pillar is to be straightened or replaced.

The finished job must be exactly right, for the pillar keeps the body and doors in alignment.

The following procedure will give excellent results.

Tools and Equipment

Welding outfit; No. 2 tip; 1⅙-in. mild-steel welding rod; disk sander; safety goggles; ball-peen hammer; screw drivers; wrenches; pick hammer; tack hammer; flat dolly; caulking iron; cold chisel; body file; Vise-Grip wrenches; hydraulic jack; hack saw; ¼-in. twist drill; ¼-in. electric drill; soldering kit.

Materials

Body solder; No. 36 closed-coat disk; No. 36 open-coat disk; primer.

Procedure

1. Study carefully Fig. 6-49. Notice damage at *D*. Cross section, Fig. 6-50, shows the construction of the pillar; the outer panel *A*; inner reinforcement assembly *B*; inner panel *C*; and trim-stick retaining channel *D*.

2. Remove the floor mats, front seat, scuff plates *E*, dome light switch *A*, upholstery panel *B*, windlace *C* and trim sticks *D* (Fig. 6-51).

3. With a hack saw cut the outer panel only at *B* to *A*, top, and *A* to *B*, bottom, around pillar (Fig. 6-49).

4. Drill the spot welds at *C*—both sides (Fig. 6-49).

a. If the spot welds are too close to the edge for drilling, cut them with a chisel.

b. Panel is now loose for removal.

c. Notice, at *C*, in Fig. 6-52, that the inner reinforcement-panel assembly is also damaged and must be removed.

5. With a hack saw, cut out the inner reinforcement-panel assembly all around panel, making these cuts ½ in. from the former and being careful not to cut the inner panel (*A* to *B*, top and bottom, Fig. 6-52).

a. Cutting the inner reinforcement-panel section shorter than the outer panel section is necessary to make welding possible (*A* to *B*, top and bottom, Fig. 6-52).

6. Place the hydraulic jack between the door sill and the top (*C*, Fig. 6-53).

7. Heat the damaged section of the trim-

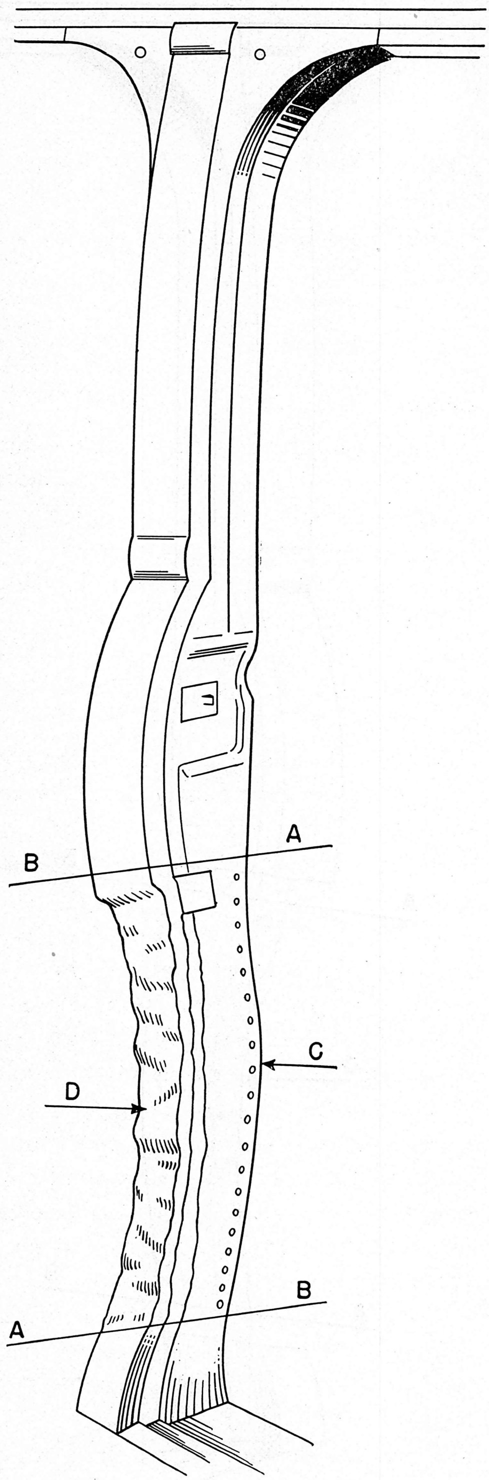

FIG. 6-49.

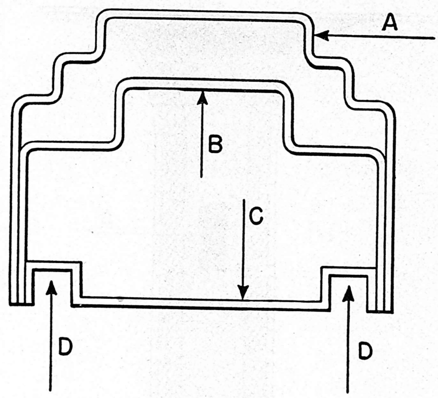

FIG. 6-50.

stick retaining channels to a cherry red (*D,* Fig. 6-53).

8. While slowly extending the jack, drive the inner panel to correct alignment.

9. When the inner panel is aligned, reheat the trim-stick retaining channels, shrink, and reshape (*D,* Fig. 6-53).

NOTE: To avoid stretching the inner panel, do not exert too much pressure on the jack while the damaged section of inner panel is hot.

10. Check the distance from *A* to *B,* Fig. 6-53, using the other center pillar as a guide.

11. Make a template (Fig. 6-54) of the center pillar, using the undamaged center pillar as a guide (see section on Making Templates, p. 37).

12. Check the damaged pillar with the template. If the pillar is not out far enough, use a second jack to push out the panel (*E,* Fig. 6-53) until it corresponds with the template.

13. Straighten the inner reinforcement assembly and outer panel sections which have been previously removed, and shrink if necessary (see section on Straightening Sheet Metal, p. 33).

14. Check the inner reinforcement-assembly section for fit.

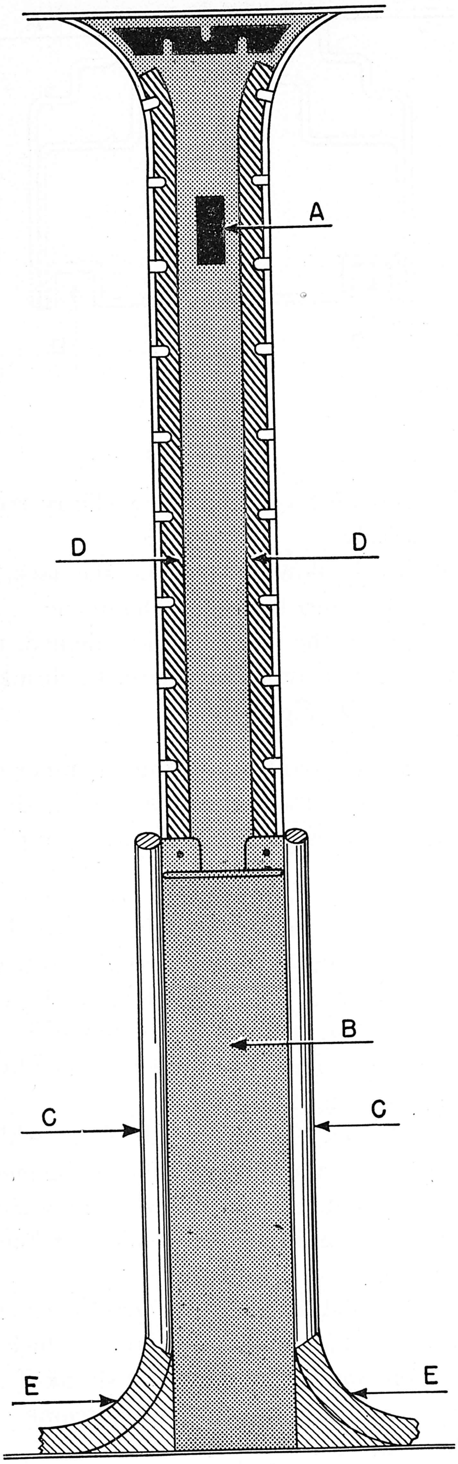

Fig. 6-51.

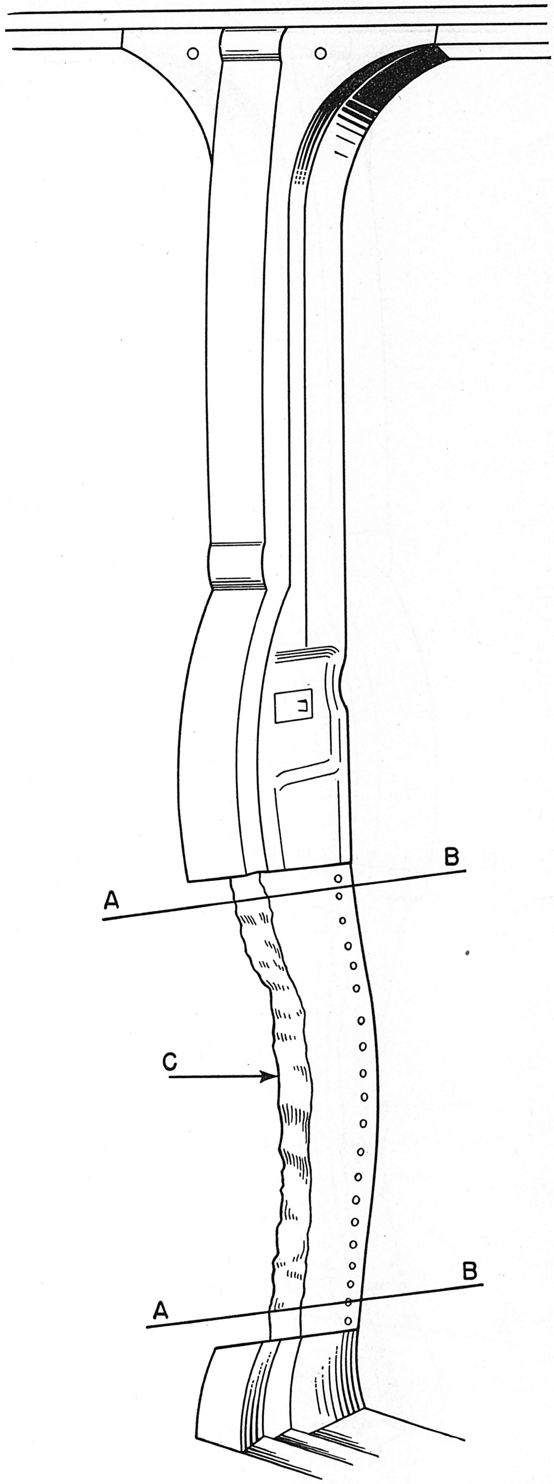

Fig. 6-52.

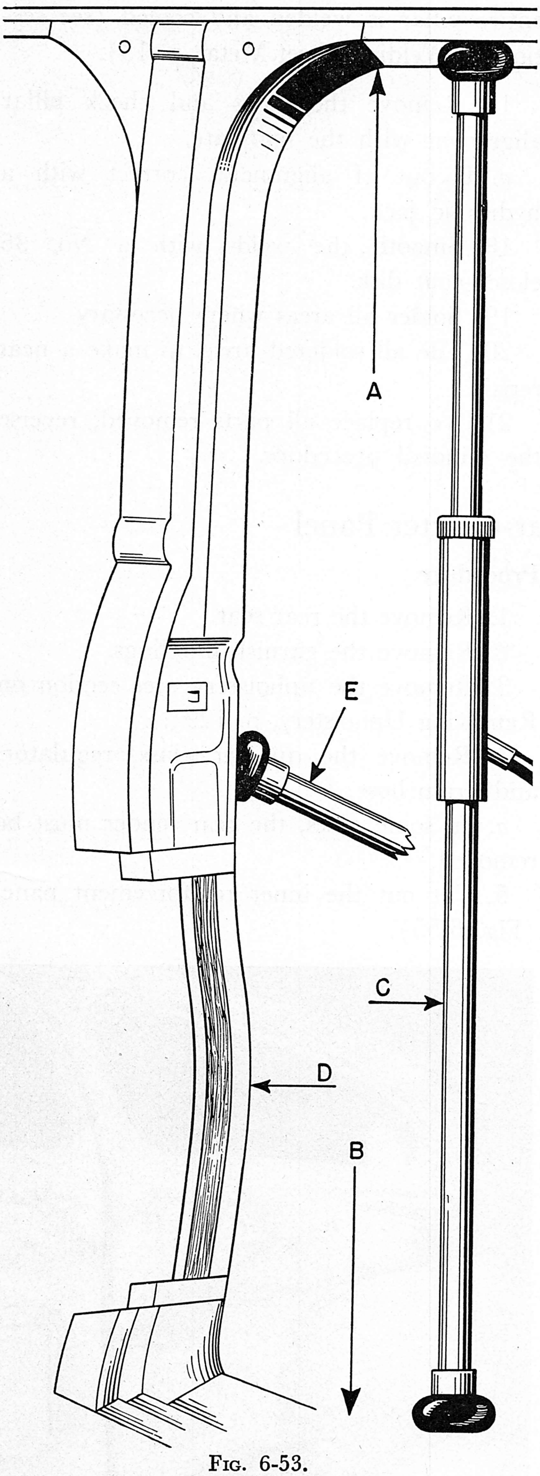

FIG. 6-53.

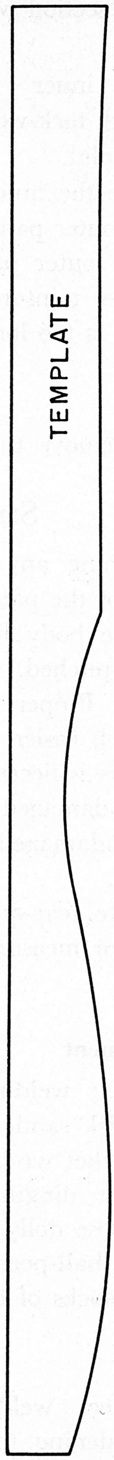

FIG. 6-54.

a. Usually this section will be too long. Trim to fit.

15. Align the inner reinforcement-assembly section and tack-weld to hold it in place; then weld solid.

a. Always prime the inner weld areas before installing the outer panel.

16. Replace the outer panel in the same manner as the inner reinforcement panel.

a. If the section is too long, trim to fit.

NOTE: Do not remove the jacks until the entire pillar is welded and cooled (see section on Welding Sheet Metal, p. 13).

17. Remove the jacks and check pillar alignment with the template.

a. If out of alignment, correct with a hydraulic jack.

18. Smooth the welds with a No. 36 closed-coat disk.

19. Solder all areas where necessary.

20. File all soldered areas to make a neat repair.

21. To replace all parts removed, reverse the removal procedure.

Straightening a Rear-quarter Panel

When straightening any large panel, the correct curvature of the panel must be maintained to keep the body lines correct. The panel usually is stretched. Careful shrinking will be necessary. Proper use of hydraulic jacks makes the job easier. Often the use of two hydraulic jacks is necessary. One is used to push out the damaged area, while the other keeps the undamaged area from being pushed out of line.

Use the opposite rear-quarter panel, if it is not damaged, for measuring and checking panel curvature.

Tools and Equipment

Hydraulic jacks; welding outfit; No. 5 tip; No. 1 tip; disk sander; safety goggles; caulking irons; socket wrenches; screw drivers; soldering kit; dinging hammer; pick hammer; all-purpose dolly; flat dolly; body file; cold chisel; ball-peen hammer; body spoons; wooden blocks of different lengths.

Materials

1/16-in. mild-steel welding rods; body solder; body deadening material; trim cement; No. 36 open-coat disk; No. 36 closed-coat disk; No. 30 S.A.E. oil.

Procedure

1. Remove the rear seat.

2. Remove the garnish moldings.

3. Remove the upholstery (see section on Removing Upholstery, p. 129).

4. Remove the quarter glass, regulator, and drain hose.

a. In some cases, the rear fender must be removed.

5. Cut out the inner reinforcement panel (Fig. 6-55).

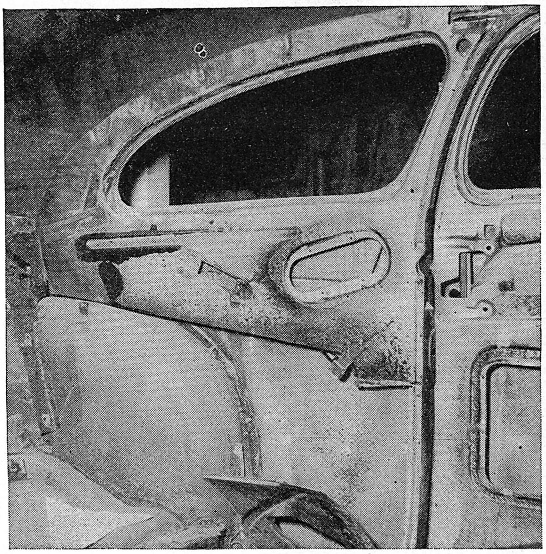

FIG. 6-55.

a. On some four-door sedans, there is no reinforcement panel, but there may be a window gutter or an inner panel to remove.

6. Push out the damage with a hydraulic jack.

7. Check the door opening for size, using the other side to get the correct dimensions.

a. A template can be made of the opposite pillar for checking.

8. Rough out the panel with a dinging hammer and dolly.

a. Use a body spoon for driving the ridges down.

9. Heat the outside of the panel and remove deadening material with a putty knife.

a. Use a No. 5 tip to heat the panel from the outside, to soften the deadening material.

10. Oil both sides of the panel with No. 30 S.A.E. oil.

11. Smooth with a Body and Fender Machine (see page 38).

12. Clean the oil from both sides of the panel.

13. Pick and file the panel.

a. Always begin filing from the undamaged portion of the panel; thus the file has a guide.

14. Shrink when necessary (see section on Shrinking Sheet Metal, p. 18).

15. Solder where necessary.

16. Replace deadening material.

17. Weld in place the reinforcement panels that were removed.

18. Reverse the removal procedure for replacing all the parts removed for straightening of the rear-quarter panel.

Straightening a Top Panel

The body mechanic who wants to do a good job of straightening a top panel must know that a very important part of the work is the restoration of the correct curvature to the top. The curvature of the metal is the support of the panel. If the crown is too low, the panel will collapse; and if it is too high, the appearance will be spoiled. The curvature must be restored before any filing is done.

A common error of this particular job is overfiling. Filing is used only for locating high spots and low spots. The paint should not be removed before this is done. Paint is an aid in seeing irregularities and helps to prevent overfiling. Too much filing creates soft spots.

Tools and Equipment

Hydraulic jack; welding outfit; No. 5 tip; No. 1 tip; dinging hammer; pick hammer; long-handle pick hammer; all-purpose dolly; flat dolly; dolly spoons; long-handle dolly; body file; Body and Fender Machine; putty knife; sliding tram; socket wrenches; screw drivers; scratch awl; soldering kit; disk sander; safety goggles; wooden blocks.

Materials

Body solder; trim cement; deadening material; deadening-material cement; adhesive solvent; No. 30 S.A.E. oil; No. 50 closed-coat disk; $\frac{1}{16}$-in. mild-steel welding rod.

Procedure

1. Remove the seats and the floor mats.

a. On some jobs the doors will have to be removed.

2. Remove the upholstery and the headlining (see section on Removing Upholstery, p. 129).

3. Remove the windshield, the rear window, and the rear-quarter glass.

4. Remove the top bows.

5. Square up the body enough to release the strains in the top panel.

a. This is only a roughing-out operation so that the top panel can be shaped.

6. Push up the top panel at the low areas with a jack, and shape roughly.

7. Drive down high ridges of the top panel with a body spoon during operation 6.

8. Remove deadening material with the putty knife.

a. To soften the deadening material, use a No. 5 tip and heat the top panel from the outside.

b. Use moderate heat to avoid scorching the paint.

9. Clean the top panel thoroughly, removing all adhesive with a solvent cleaner.

a. Be careful of fire. Keep the solvent cleaner away from open flame.

b. Do not use lacquer thinner. It may drip and damage the paint, making unnecessary work.

10. Reshape the top-panel curvature.

a. As you shape, keep sighting the panel Figs. 6-56 and 6-57).

b. Begin sighting from a stooping position, because as you straighten up, you can see the line of the curvature from the roof rail to the center of the top panel. Sighting from the front and from the rear, you can see the curvature from the roof rail to roof rail.

11. Square up the body.

a. The top panel may have to be shaped some more during the squaring of the body.

12. Adjust the doors.

13. Cover both sides of the top panel with a thin film of oil.

a. The oil film allows the Body and Fender Machine to operate more freely (see the section on Using a Body and Fender Machine, p. 38).

14. Smooth the top panel with a Body and Fender Machine.

15. Clean the oil from both sides of the top panel.

16. Pick and file the top panel along the roof rails.

a. Beginning at the drip moldings, pick and file a strip 12 in. wide from the front to the back (*A* and *B,* Fig. 6-58), and return from back to front on the other side.

b. Always file lengthwise as arrows indicate in Fig. 6-58. The file must touch as much of the surface as possible.

17. Pick and file the top panel above the windshield opening, making a strip 18 in.

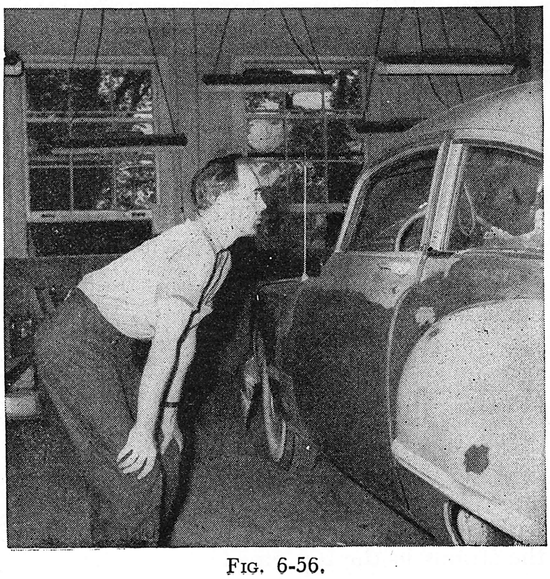

Fig. 6-56.

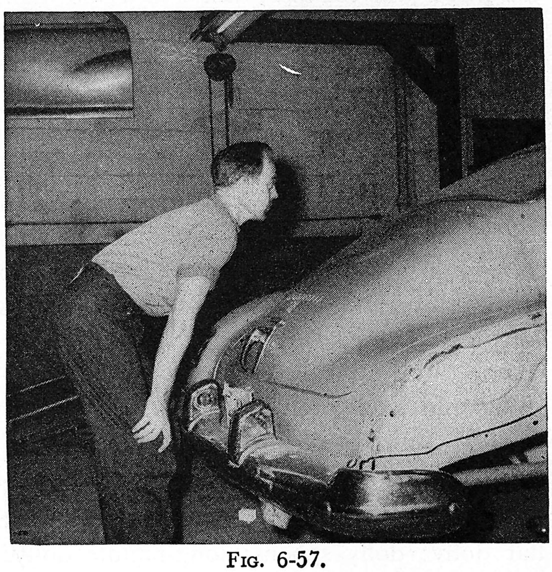

Fig. 6-57.

wide and filing in the direction of the arrows (*C*, Fig. 6-58).

18. Pick and file the top panel above the rear window, making the strip about 18 in. wide (*D*, Fig. 6-58).

19. Pick and file a strip about 18 in. wide on the top panel on both sides, as shown at *E* and *F* in Fig. 6-58, filing in the direction of the arrows.

20. Finish picking and filing the remaining area in the center of the top panel, filing in the direction of the arrows, as shown at *G, H,* and *I* in Fig. 6-58.

21. Cross-file the center of the roof, as in Fig. 6-59.

a. Remember to push the file at a 30-deg. angle.

NOTE: If a soft spot should occur, a short length of pipe should be held under the spot, and the thin metal driven into the opening of the pipe with the peening end of a ball-peen hammer. The dent thus made should be soldered (see section on Soldering Small Dents in Panels, p. 26).

22. Solder the areas that cannot be reached by picking and filing.

a. These places are close to the drip molding and above the windshield posts.

b. Do not use solder unless it is absolutely necessary.

23. Sand out file marks with a No. 50 closed-coat disk.

a. Be careful not to heat the top panel with friction; sand lightly, and do not sand too long on one spot.

24. Replace deadening material.

25. Straighten the top bows and replace them.

26. Replace all glass.

27. Replace upholstery (see section on Installing Upholstery, p. 132).

28. Replace seats and floor mats.

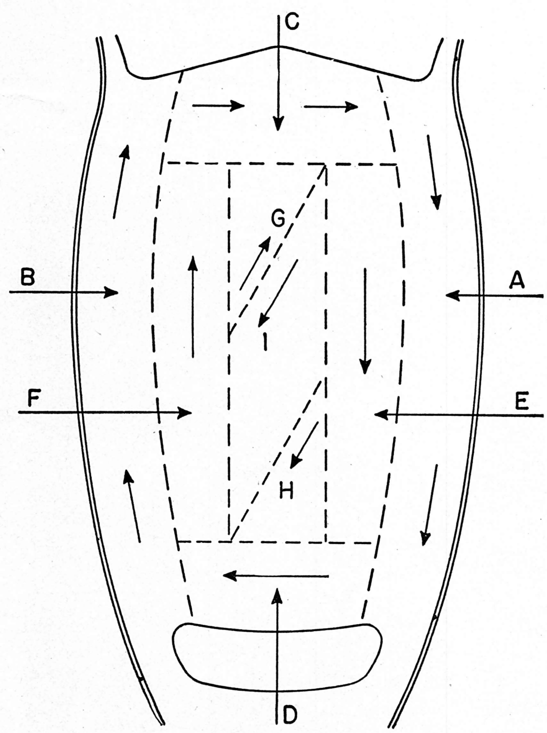

Fig. 6-58.

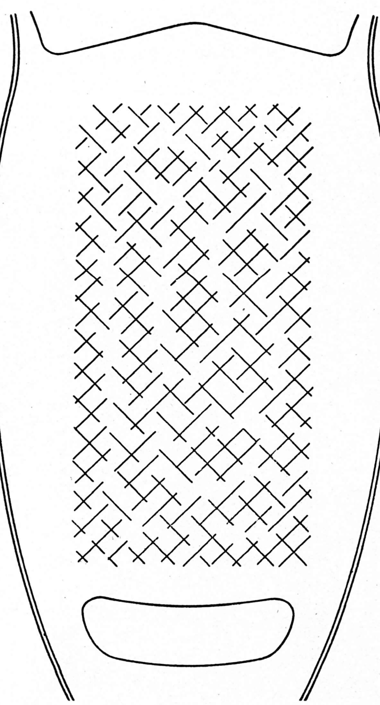
Fig. 6-59.

Questions

1. When should a fender patch be used?
2. Why is a weld around a patch forged?
3. How should solder be filed along the edge of a panel?
4. Name operations in removing an outer rocker panel.
5. What adjustments can be made when hood is too close to either side of the radiator saddle?
6. Why should hinges be replaced on the exact spot from which they were removed?
7. What is the most important factor in trunk-[illegible] straightening?
8. Why are inner door-panel edges cut with a hack saw?
9. Why is a template of the outer panel necessary?
10. How can the opposite undamaged panel be helpful in straightening a rear-quarter panel?
11. What is the common error that is made in straightening a top panel?

CHAPTER 7

Body-panel Removal and Replacement

Replacing Lower Trunk Panels

Single panels can usually be straightened without much difficulty. But it is recommended that double panels be replaced if the damage is at all extensive.

Here again a time element is involved, and careful consideration must be given such damage to determine the best and least costly way to repair it. On older cars this panel is usually badly rusted, and replacement is necessary.

The following procedure makes replacement comparatively simple.

Tools and Equipment

Welding outfit: No. 2 welding tip; cutting attachment; No. 2 cutting tip; disk sander; safety goggles; Vise-Grip wrench; dinging hammer; all-purpose dolly; soldering kit; body file; cold chisel; hack saw.

Materials

Body solder; 3⁄32-in. mild-steel welding rod; lower trunk panel; No. 36 open-coat disk; No. 36 closed-coat disk.

Procedure

1. Cut the corners with the hack saw at points *A,* Fig. 7-1.

2. Cut tack welds, fastening the panel to the trunk floor with a chisel (*E,* Fig. 7-1).

3. Cut both sides of the panel from *A to B,* in Fig. 7-1, with a cutting torch.

a. Always take the necessary fire precautions when using a cutting torch on any part of an automobile.

b. The top and sides of the panel should now be free.

4. Grasp the top of the panel, and move

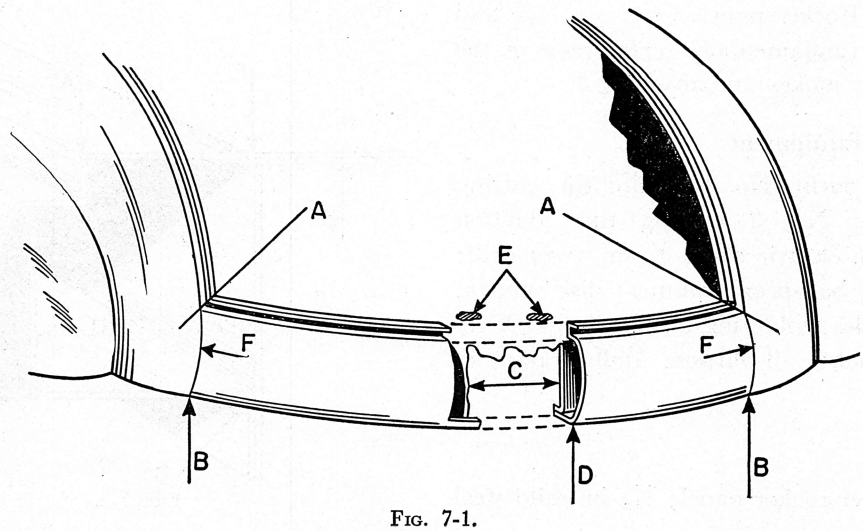

FIG. 7-1.

it in and out until the spot welds break at the bottom of the panel (*D,* Fig. 7-1).

5. Smooth the edges from *A* to *B,* in Fig. 7-1, with a No. 36 closed-coat disk.

6. Straighten the inner panel if necessary (*C,* Fig. 7-1).

7. Place the panel in position for installation, checking for fit at both sides (*A* and *B,* Fig. 7-1).

8. Hold the panels in place by clamping a Vise-Grip wrench on the lower flanges.

9. Tack-weld the panel at the upper corners (*A,* Fig. 7-1).

10. Close the trunk lid, and check for fit.

11. Tackweld the panel at the lower corners (*B,* Fig. 7-1).

12. Complete welding both sides *A to B,* in Fig. 7-1, with a flat weld.

13. Tack-weld the panel to the trunk floor, duplicating factory welds (*E,* Fig. 7-1).

14. Tack-weld the outer and inner panels at *D,* Fig. 7-1.

15. Smooth the welds at both joints from *A* to *B,* Fig. 7-1, with a No. 36 closed-coat disk.

16. Solder-fill both joints of the panel from *A* to *B,* Fig. 7-1.

17. File the solder level with the panels at both sides from *A* to *B,* Fig. 7-1.

18. Make a small groove on both sides at points *E,* Fig. 7-1, to correspond with the original factory assembly.

Replacing Rocker Panels

Rocker panels are boxlike sections consisting of inner and outer panels welded to the edge of the floor pan. These sections form the body section below the doors.

Straightening rocker panels usually involves cutting away the inner panel or removing the outer panel. Replacement is generally advisable when such cutting is necessary. Good judgment must be used when estimating time of repair against time of replacement. Rocker panels vary as to size and shape, but fundamentally replacement is the same on all makes and models.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; aviation snips; ¼-in. electric drill; $\frac{3}{16}$-in. twist drill; cold chisel; ball-peen hammer; disk sander; safety goggles; soldering kit; body file; Vise-Grip wrench; all-purpose dolly; peening hammer.

Materials

New outer rocker panel; $\frac{1}{16}$-in. mild-steel welding rod; body solder; No. 36 open-coat disk; No. 36 closed-coat disk; $\frac{3}{32}$-in. bronze welding rod; brazing flux; primer.

Procedure

1. Study carefully the cross section, Fig. 7-2, which shows the various parts: *F* floor pan, *G* inside rocker panel, *H* outer rocker panel, *I* molding.

2. Remove the step or scuff plates.

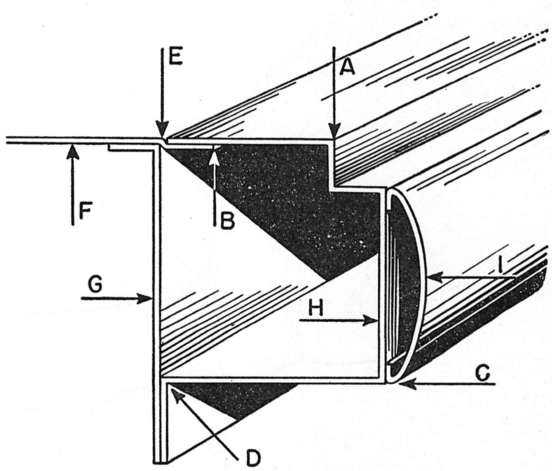

Fig. 7-2.

3. Fold back the floor mat, loosen the upholstery and windlace.

a. Take the necessary fire precautions.

4. Remove the molding and clips.

5. Cut along lines *C,* Fig. 7-3, with a cutting torch.

a. To allow for smoothing, cut a short distance from the welds or pillars.

b. Begin the cut at *A,* continue to *B,* where double sheet metal begins. Then cut from *A* to *C* and from *C* to *D,* Fig. 7-2.

6. Cut outside of the spot welds from post to post, along *D,* Fig. 7-3, through the single sheet metal (*B,* Fig. 7-2).

7. Cut from front to back at *D* in Fig. 7-2.

a. The cutting torch should point upward, to prevent cutting the inner rocker panel.

8. Cut from *A* to *B,* Fig. 7-3, below the center pillar.

9. Remove the strips remaining on the floor pan and the inner rocker panel by breaking the spot welds.

a. If the welds do not break, drill the spot welds with a 3⁄16-in. twist drill.

10. Straighten the inner panel if necessary.

11. Smooth all areas where cuts were made with a No. 36 closed-coat disk.

12. Trim the new rocker panel with aviation snips to fit points *E,* Fig. 7-3.

a. Originally the rocker panels were placed under the pillars; therefore, trimming the new panel is necessary.

13. Fit the new rocker panel in place.

14. Fasten the rocker panel at *F,* Fig. 7-3, with a Vise-Grip wrench.

15. Tack-weld the panel at the top corners (*E,* Fig. 7-2).

16. Tack-weld at the bottom, using welding clamps for holding.

17. Weld the panel from *A* to *B,* Fig. 7-3.

18. Weld the panel all around (see section on Welding Sheet Metal, p. 13).

19. Smooth all the welds with a No. 36 closed-coat disk.

20. Solder where necessary.

21. Smooth all the soldered areas with a No. 36 open-coat disk.

22. Prime all the bare metal (see chapter on Painting Equipment and Techniques, p. 110).

23. Replace all the parts by reversing the removal procedure.

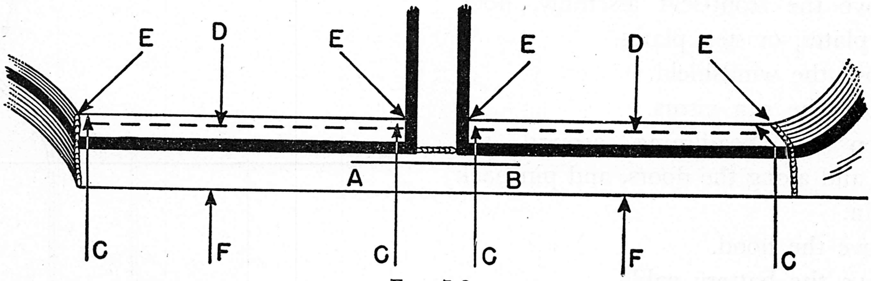

FIG. 7-3.

Removing the Cowl Assembly

Before beginning to remove a cowl assembly, have the new assembly on hand ready for installation. Be sure that it is the right type, as cowl assemblies come in one piece, two pieces, and three pieces.

When removing the cowl assembly, be careful with the parts that are removed. Have trays handy for storing small parts. Windshield glass must be stored in a safe place. Doors must be placed where the paint will not be damaged or the glass broken.

List all cracked glass before beginning the

job, and ask the customer to sign the list. This can be done in the spirit of better relationship with the customer and is for the protection of both him and you.

Tools and Equipment

Socket wrenches; screw drivers; welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; hack saw; Vise-Grip wrench; disk sander; safety goggles; ¼-in. electric drill; 3/16-in. twist drill; cold chisel; ball-peen hammer; steel rule; wire brush.

Materials

Cowl assembly; No. 36 closed-coat disk.

Procedure

1. Remove the doors, and measure the distance of the lower door opening from the cowl to the center pillar, saving these measurements as an aid in installing the new cowl.

a. Always put a wire in the door check strap so the strap does not drop into the door.

2. Remove the front-seat assembly, floor mat, scuff plates, or step plates.
3. Remove the windshield.
4. Remove the sun visors.
5. Loosen the headlining around the windshield and along the doors, and pin back about 18 in.
6. Remove the hood.
7. Remove the battery cable.
8. Remove the hood-latch cable.
9. Drain the radiator, and remove the radiator, fenders, and grille in one unit.

a. Save the radiator solution if it is antifreeze.

10. Unhook the hinge springs, and remove the hinges from the cowl.
11. Loosen all wiring coming through the dash at the motor end.
12. Remove the grommets, and pull the wires through the dash.
13. Remove the kick pads.
14. Disconnect all wires from the heaters, radio, electric-wiper motor, and all wiring attached to the cowl.

a. Code-mark the wires that must be cut.

15. Remove the instrument panel.
16. Loosen the windlace, and pin back as far as the headlining.
17. Remove the cowl-ventilator assembly.
18. Remove the parking-brake assembly from the cowl.
19. Remove the heaters, radio, and all accessories fastened to the cowl.
20. Remove the transmission-floor-cover assembly.
21. Locate the wires running through the windshield post, and pull them out from the top of the post.
22. Remove the body bolts from the cowl assembly (*B* and *C*, Fig. 7-4).
23. Examine the new cowl assembly to

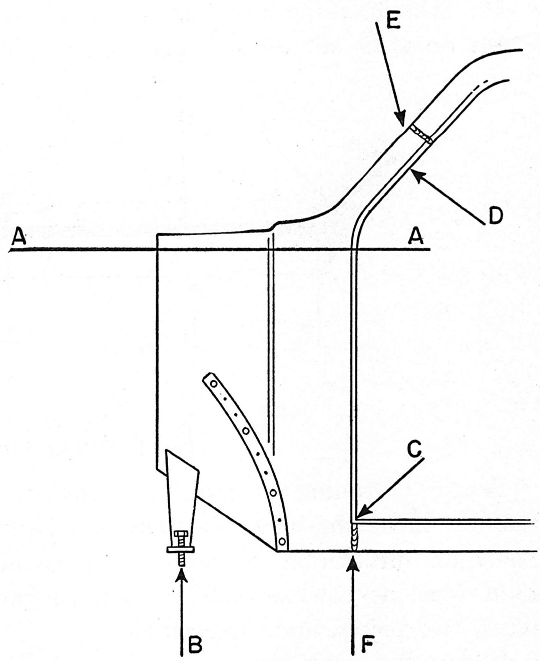

Fig. 7-4.

see what parts must be salvaged from the old assembly, such as the drip molding (*D,* Fig. 7-4).

24. Locate soldered welds on the windshield posts by applying heat and removing the solder with a wire brush (*E,* Fig. 7-4).

a. On some cars the upper cowl panel is part of the top assembly and is spot-welded along *A* (Fig. 7-4).

25. Make a template of the windshield opening (see section on Making Templates p. 37).

26. Cut the windshield posts below the welds with a hack saw (*E,* Fig. 7-4).

27. Cut the cowl assembly from the rocker panels (*F,* Fig. 7-4).

28. Cut the toe pan from the floor pan (*A* and *B,* Fig. 7-5).

29. Cut the windshield center strip from the cowl (*C,* Fig. 7-5).

30. Cut out a piece from the toe pan where the steering column passes through (*D,* Fig. 7-5).

a. Use a hack saw to cut the piece.

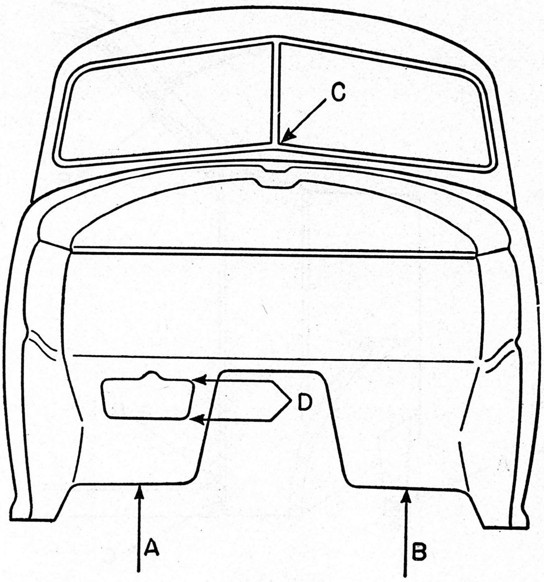

Fig. 7-5.

b. This saves removal of the steering assembly.

31. Remove the cowl assembly.

32. To make installation of the new assembly easier, use a disk sander and a No. 36 closed-coat disk to smooth all cuts.

Installing the Cowl Assembly

The careful measurements made before removing the old assembly and the template of the windshield opening are used to secure accuracy in installing the new cowl assembly. After the cowl has been tack-welded, a check should be made before welding it solid.

Be neat in your work. It is the little details that are so easily overlooked which make a job look "patched up."

Remember, a good job should always look exactly like the original.

Tools and Equipment

Welding outfit; No. 1 tip; No. 2 tip; socket wrenches; screw drivers; Vise-Grip wrench; 6-in. C clamps; disk sander; safety goggles; soldering kit; body file; ¼-in. electric drill; $\frac{3}{16}$-in. twist drill; steel rule; wire brush; hack saw.

Materials

Body cowl assembly; body solder; No. 36 open-coat disk; No. 36 closed-coat disk; $\frac{1}{16}$-in. mild-steel welding rod; primer; ⅛-in. bronze rod; brazing flux.

Procedure

1. Cut opening in the toe pan to slide the steering column into the new cowl assembly.

2. Position the cowl assembly.

a. Be sure the rubber insulators are between the cowl and the frame.

3. Replace the body bolts in the cowl assembly, and start the nuts on the bolts (*A* and *B,* Fig. 7-6).

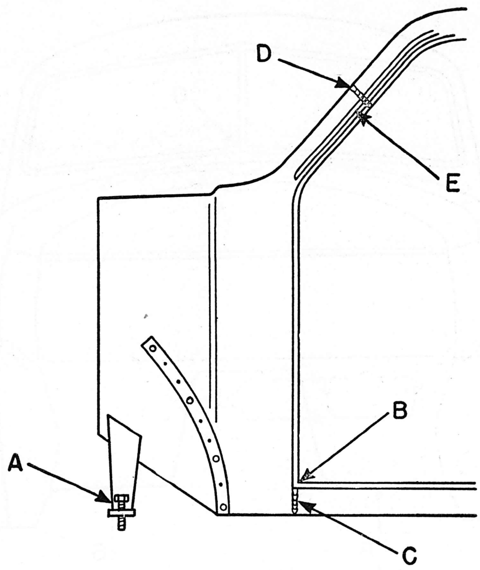

Fig. 7-6.

a. Do not tighten the bolts until after the welding is completed.

b. Tightening the body bolts before welding throws the cowl out of line.

4. Check the windshield opening with the template.

5. Clamp the cowl assembly in place on the windshield-post flanges with a Vise-Grip wrench.

6. Check the measurements at the lower cowl assembly.

a. The distance between the cowl and the center pillar must be the same as it was originally.

b. Use the measurement taken before the cowl was removed.

7. Tack-weld the cowl assembly to the rocker panel (*C,* Fig. 7-6).

8. Check windshield opening again with the template, and then tack-weld at windshield posts (*D,* Fig. 7-6).

a. Make sure all measurements check.

9. Weld solid at the rocker panels and windshield posts.

10. Weld the toe pan to the floor pan, and weld in place the small section which was removed for steering column entrance.

11. Tighten the body bolts.

12. Spot-weld the drip molding in place (*E,* Fig. 7-6. See also Procedure 6, Spot Welding, in the section on Welding Sheet Metal, p. 13).

13. Solder the welds at *C* and *D,* Fig. 7-6.

14. Clean and prime the surface of the cowl assembly.

15. Weld the windshield center strip to the cowl.

16. Reverse the removal procedure for installing all parts that were removed (see section on Removing the Cowl Assembly, p. 89).

17. Align doors (see section on Aligning Door Hinges, p. 49).

18. Align hood hinges (see section on Adjusting Hood Hinges, p. 46).

Replacing a Center Pillar

When the damage to a pillar is beyond repair, it must be replaced. In replacing a pillar, as in repairing it, there is a problem of alignment.

Tools and Equipment

Welding outfit; No. 2 tip; hydraulic jack; disk sander; safety goggles; socket wrenches; hack saw; cold chisel; ball-peen hammer; tack hammer; Vise-Grip wrench; dinging hammer; all-purpose dolly; screw drivers; soldering kit; wire brush.

Materials

New center pillar; $\frac{1}{16}$-in. mild-steel welding rod; body solder; No. 36 open-coat disk; No. 36 closed-coat disk; $\frac{3}{32}$-in. bronze welding rod; brazing flux; primer.

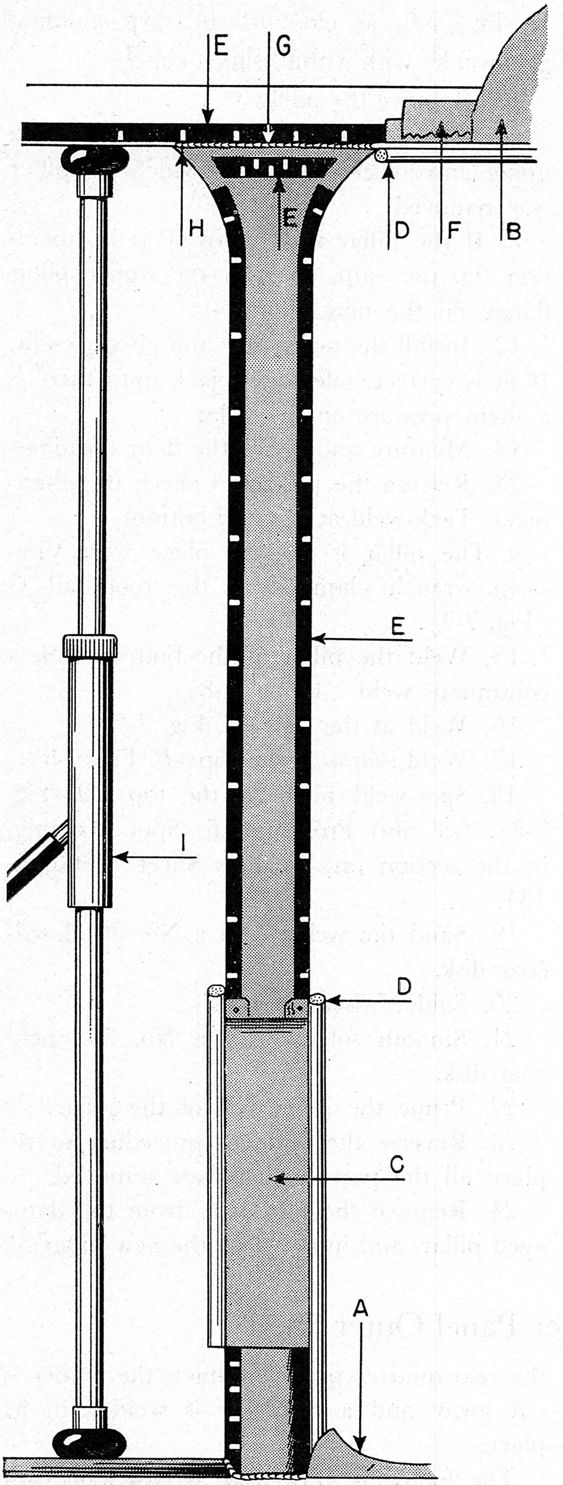

FIG. 7-7.

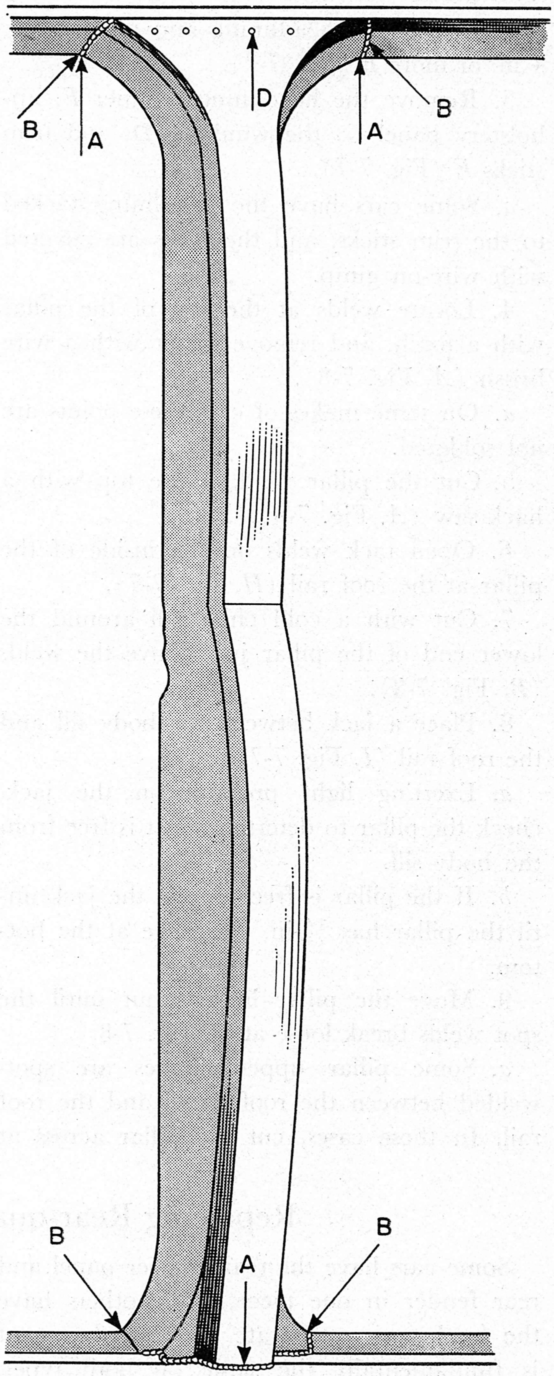

FIG. 7-8.

Procedure

1. Remove the floor mats, front seat, and scuff plates (*A,* Fig. 7-7).

2. Loosen the headlining and pin it back 4 in. or more *B* (Fig. 7-7).

3. Remove the headlining retainer *F,* upholstery panel *C,* the windlace *D,* and trim sticks *E* (Fig. 7-7).

a. Some cars have the headlining tacked to the trim sticks, and the tacks are covered with wire-on gimp.

4. Locate welds at the top of the pillar with a torch, and remove solder with a wire brush (*A,* Fig. 7-8).

a. On some makes of cars these points are not soldered.

5. Cut the pillar weld at the top with a hack saw (*A,* Fig. 7-8).

6. Open tack welds on the inside of the pillar at the roof rail (*H,* Fig. 7-7).

7. Cut with a cold chisel all around the lower end of the pillar just above the welds (*B,* Fig. 7-8).

8. Place a jack between the body sill and the roof rail (*I,* Fig. 7-7).

a. Exerting light pressure on the jack, check the pillar to determine if it is free from the body sill.

b. If the pillar is free, extend the jack until the pillar has ½-in. clearance at the bottom.

9. Move the pillar in and out until the spot welds break loose at *D,* Fig. 7-8.

a. Some pillar upper flanges are spot-welded between the roof panel and the roof rail. In these cases, cut the pillar across at *D,* Fig. 7-8, as close to the drip molding as possible, with a thin, sharp chisel.

10. Remove the pillar.

11. With a No. 36 closed-coat disk, smooth upper and lower areas from which the pillar was removed.

a. If the pillar was removed as in operation 9*a,* use snips to trim the upper pillar flange on the new pillar.

12. Install the new pillar and check for fit. If fit is correct, release the jack until there is a slight pressure on the pillar.

13. Measure and check the door openings.

14. Release the jack, and check the alignment. Tack-weld at top and bottom.

a. The pillar is held in place with Vise-Grip wrench clamped to the roof rail *G* (Fig. 7-7).

15. Weld the pillar at the bottom with a continuous weld (*A,* Fig. 7-8).

16. Weld at the top (*H,* Fig. 7-7).

17. Weld seams at the top (*B,* Fig. 7-8).

18. Spot-weld pillar at the top (*D,* Fig. 7-8). See also Procedure 6, Spot Welding, in the section on Welding Sheet Metal, p. 13).

19. Sand the welds with a No. 36 closed-coat disk.

20. Solder where necessary.

21. Smooth solder with a No. 36 open-coat disk.

22. Prime the inner side of the pillar.

23. Reverse the removal procedure to replace all the parts which were removed.

24. Remove the hardware from the damaged pillar, and install it on the new pillar.

Replacing Rear-quarter Panel Outer Shell

Some cars have the rear-quarter panel and rear fender in one piece, while others have the fender as a separate unit. Replacement is fundamentally the same on both types. When the fender is damaged but the rest of the rear-quarter panel is intact, the fender is cut away and a new one is welded in its place.

The following procedure is based on fundamental operations applicable to all types.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; disk sander; safety goggles; socket set; screw drivers; soldering kit; hack saw; ¼-in. electric drill; $\frac{3}{16}$-in. twist drill; cold chisel; ball-peen hammer; sheet-metal chisel; dinging hammer; all-purpose dolly; Vise-Grip wrench; 6-in. C clamps; body file; aviation snips.

Material

New quarter-panel outer shell; No. 36 open-coat disk; No. 36 closed-coat disk; $\frac{1}{16}$-in. mild-steel welding rod; trim cement; weather-strip cement; body solder; body deadener; $\frac{3}{32}$-in. bronze welding rod; brazing flux; primer.

Procedure

1. Remove the rear cushions.
2. Remove the rear-window garnish molding.
3. Remove the rear-quarter window.
4. Loosen the headlining and pin it back.
5. Remove the floor mat.
6. Remove the scuff plate or step plate.
7. Remove the upholstery panel.
8. Remove the windlace.
9. Remove the trim sticks.
10. Remove the rocker panel molding.
11. Place stands under the rear of the car.
12. Remove the wheel.
13. Remove the fender if the fender is a separate unit.
14. Remove trunk-gutter rubber (*A,* Fig. 7-9).

a. On some cars, removal of the trunk lid may be necessary.

15. Locate soldered welds with a torch, and remove the solder with the wire brush at points *B,* Fig. 7-9.
16. Cut the weld at the top of the panel with a hack saw (*C,* Fig. 7-9).
17. Drill the spot welds along the post (*D,* Fig. 7-9. Also see *A* in cross section, Fig. 7-10).

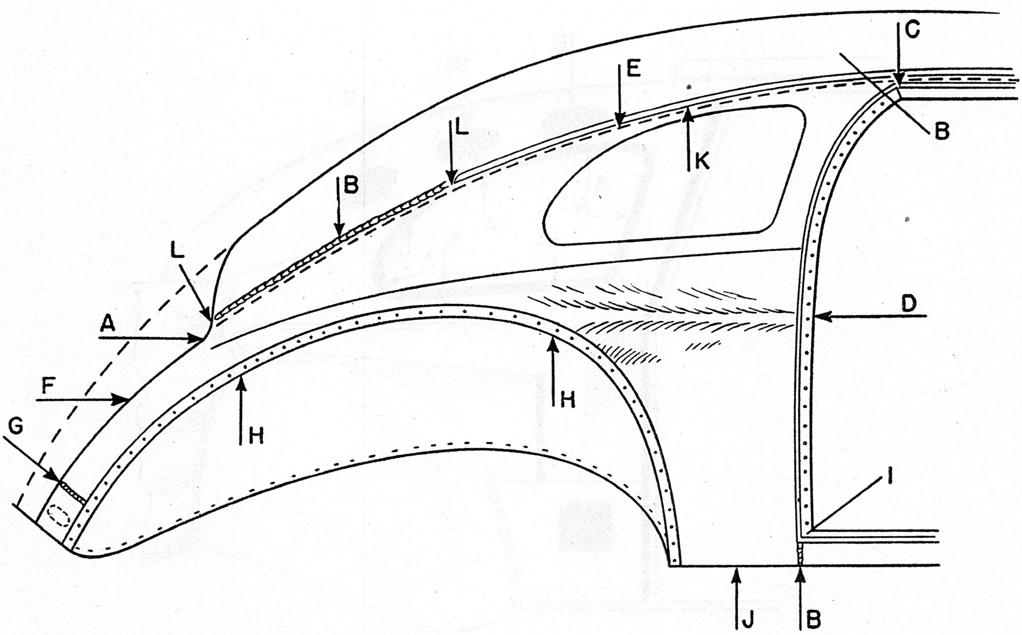

Fig. 7-9.

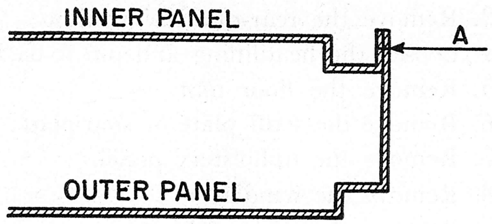

Fig. 7-10.

18. With a sheet-metal chisel cut the upper part of the panel ½ in. below the drip molding (*E,* Fig. 7-9).

19. Drill the spot welds in the trunk gutter (*F,* Fig. 7-9).

a. Some cars have an extra section for the taillight (*G,* Fig. 7-9).

b. Locate the weld of this panel by feeling the inside of the quarter panel.

c. If there is an extra section, cut the panel above the weld.

20. Drill the spot welds which join the quarter panel and wheel housing (*H,* Fig. 7-9).

21. Drill the spot welds around the window opening (*A,* Fig. 7-11).

22. Cut the lower end of the post along the weld with a chisel (*I,* Fig. 7-9).

23. Work the panel in and out until the spot welds along the lower end of the panel and inside the rocker panel break (*J,* Fig. 7-9).

24. Drill the spot welds along the roof rail from underneath, and remove the remaining strip of panel left when the cut was made in operation 18.

25. Trim the edge of the roof from *L* to *L,* Fig. 7-9.

26. Smooth all cuts and welds with a No. 36 closed-coat disk.

27. Install the new panel, and hold it in place with a Vise-Grip wrench and C clamps at points *F,* Fig. 7-12.

28. Tack-weld at points *G,* Fig. 7-12.

29. Hold the panel at *H,* Fig. 7-12, with the Vise-Grip wrench, and tack-weld.

30. Tack-weld at *I,* Fig. 7-12.

31. Clamp the inner and outer panels together with C clamps in the window opening, and spot-weld tabs at points *A,* Fig. 7-11.

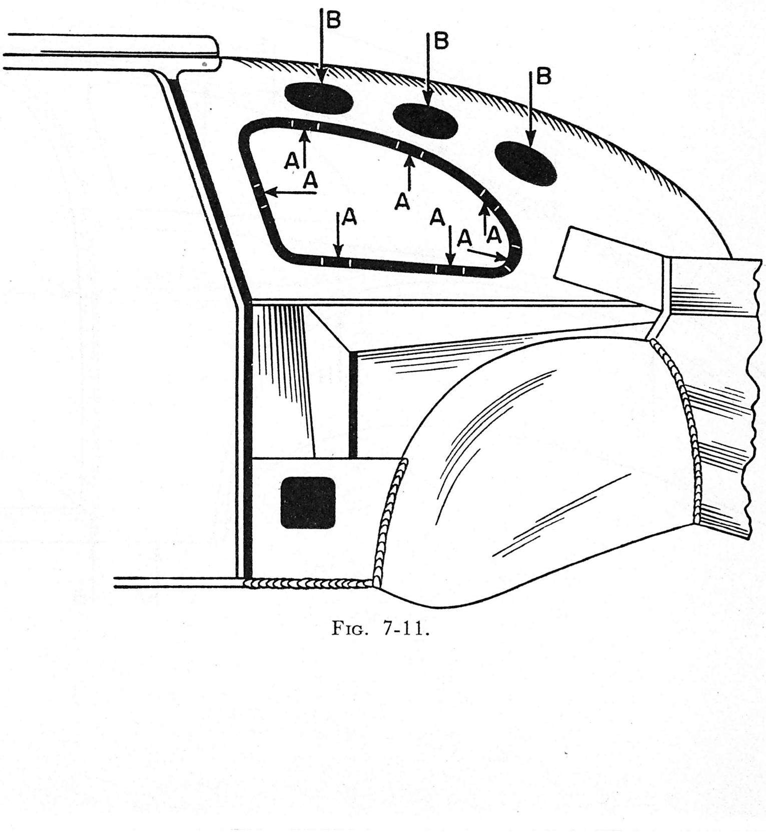

Fig. 7-11.

32. Place wet asbestos paper on the roof above the drip molding (*C,* Fig. 7-12).

33. Tack-weld the quarter panel to the roof panel from the inside through holes in the inner panel at points *B,* Fig. 7-11.

a. In some cars that have solid inner panels, the welding must be done over and behind the roof rail.

34. Clamp the inner and outer panels together along the inside edge of the post, and spot-weld (*J,* Fig. 7-12. See also *A* in cross section, Fig. 7-10).

35. Complete the welds at the top and bottom at points *G,* Fig. 7-12.

36. Weld the quarter panel and the roof panel together from *A* to *B,* Fig. 7-12.

37. Spot-weld the panel to the trunk gutter from *B* to *C,* Fig. 7-12.

38. Spot-weld the panel to the wheel housing from *D* to *E,* Fig. 7-12.

39. Smooth all welds showing on the outer surfaces.

40. Solder where necessary.

41. Finish with a body file.

42. Check the roof panel for warp from the welding heat.

a. The roof panel need not be warped if asbestos paper has been kept wet.

b. Heat must be absorbed by the wet asbestos paper and not by the roof panel.

43. Straighten the roof panel if it is warped.

44. Apply body deadener, and prime all inside surfaces to protect them from rust.

45. Replace all parts that were removed by reversing the removal procedure.

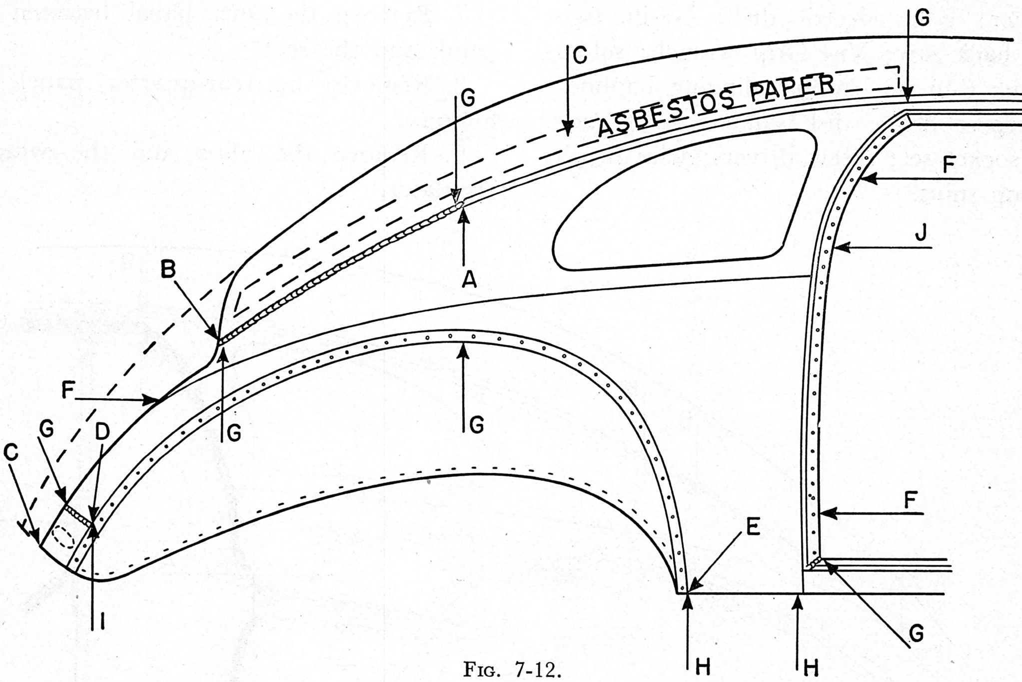

FIG. 7-12.

Removing Rear-quarter Panel Assembly

Often the damage on the rear-quarter panel is so severe that replacement of the entire section is the only solution. A side blow can damage a rear-quarter panel so badly that straightening would involve higher labor cost than replacement and would not produce a satisfactory result.

Before removing a panel that is to be re-

placed, the new one must be on hand for comparison, to determine whether or not there are minor differences in construction, making it necessary to save some parts of the old panel.

A rear-quarter panel has two sections, an inner reinforcement panel and an outer shell.

When replacing a rear-quarter panel, the following step-by-step procedure should be followed very carefully. Careless removal will make it difficult to install the new panel. Remember, time is an important factor in body work.

Tools and Equipment

Welding outfit; No. 2 welding tip; cutting attachment; No. 2 cutting tip; hydraulic jack; sheet-metal chisel; ball-peen hammer; ¼-in. electric drill; 3/16-in. twist drill; hack saw; Vise-Grip wrench; soldering kit; 6-in. C clamps; dinging hammer; all-purpose dolly; disk sander; safety goggles; socket set; screw drivers; wire brush; aviation snips.

Materials

New quarter panel; 3/32-in. mild-steel welding rod; body solder; No. 36 closed-coat disk.

Procedure

1. Study damage in Fig. 7-13.

NOTE: The lock pillar on the rear-quarter panel, the outside panel, and the section above the wheel housing are severely damaged.

2. Remove the floor mats.
3. Remove the scuff plates.
4. Remove the rear seat.
5. Remove the rear-window garnish molding.
6. Remove the rear shelf cover.
7. Remove the dust panel between the trunk and the seat.
8. Remove the rear-quarter panel upholstery.
9. Remove the glass and the window regulator.

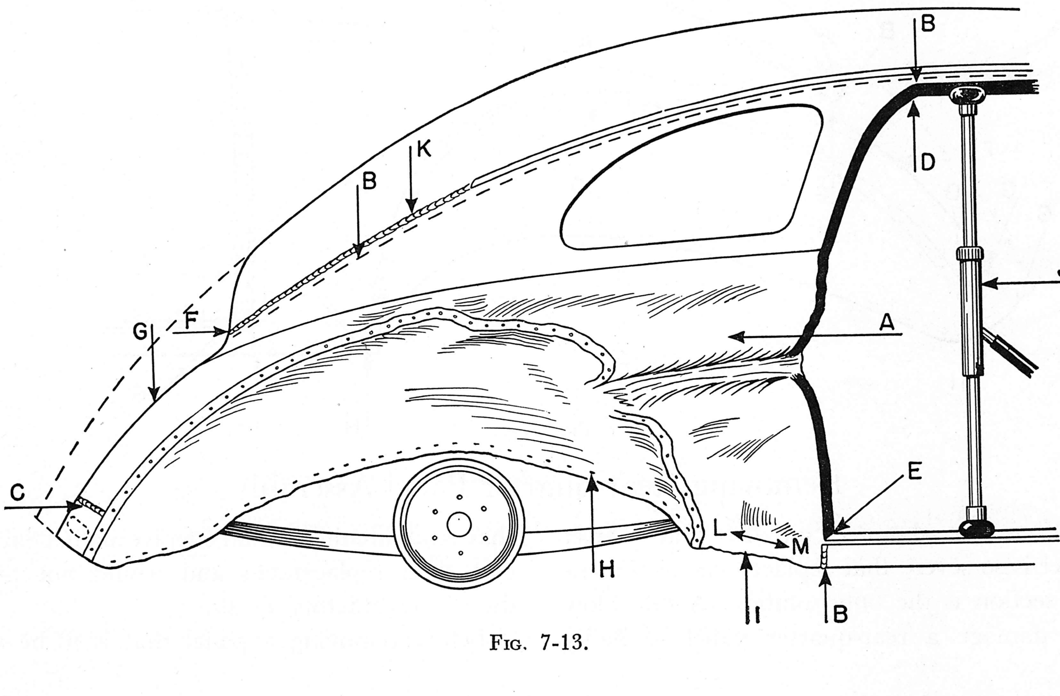

Fig. 7-13.

10. Remove the window channel.

11. Remove the window drain hose (*A*, Fig. 7-14).

12. Loosen the headlining and pin it back far enough to get at the upper part of the quarter panel.

13. Remove the trim sticks (*B*, Fig. 7-14).

14. Remove the trunk lid and gutter rubber.

a. Remove the gutter rubber on the damaged side only.

15. Jack up the car.

16. Put a stand under the housing.

17. Remove the wheel and fender.

a. When the fender is undersealed, time can be saved by heating an old socket of the correct size to remove the fender bolts.

NOTE: Where bolts are rusted badly and are liable to break, heat the bolts to a cherry red before removing.

18. Locate the welds with a torch, and remove the solder with a wire brush at points *B*, Fig. 7-13.

a. Some cars have an extra section for the taillight (*C*, Fig. 7-13).

b. The weld on the extra section can be located by feeling the inside of the panel.

19. Cut the weld with a hack saw (*D*, Fig. 7-13).

a. Always cut close to the weld in the section to be removed.

20. Cut the weld with a cutting torch, leaving enough metal to trim with a sanding disk (*E*, 7-13).

a. To determine how much should be cut from the old panel, examine the new panel before cutting.

21. Cut the upper part of the panel with a sheet-metal chisel ½ in. below the drip molding and the weld (*F*, 7-13).

22. Locate and drill the spot welds in the

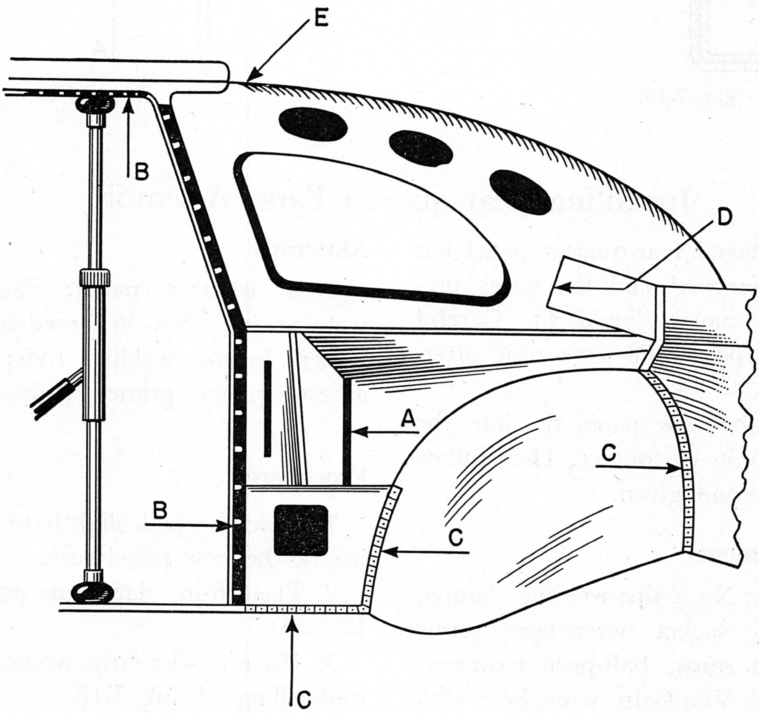

Fig. 7-14.

trunk gutter (*G,* Fig. 7-13). See cross section of trunk gutter and panel (*A,* Fig. 7-15).

23. Drill the spot welds along the wheel housing and floor pan (*H,* Fig. 7-13).

24. Use a cutting torch to cut from *L* to *M,* Fig. 7-13.

a. To avoid a fire hazard, be sure to remove all body deadener before cutting.

25. Cut all inside braces close to the floor at points *C,* Fig. 7-14.

26. Cut the brace at the rear shelf with a chisel (*D,* Fig. 7-14).

27. Open the welds at the roof rail (*E,* Fig. 7-14).

a. Use a chisel to avoid damaging the roof rail.

28. Remove the panel.

29. Place a jack between the sill and the roof rail (*J,* Fig. 7-13).

30. Drill the spot welds on the roof rail from the underside (*A,* Fig. 7-16).

a. Be careful not to damage the roof with the drill.

31. Remove the section just drilled as far back as the drip molding.

32. Trim the edge from the end of the drip molding to the trunk gutter with aviation snips, to allow the new panel to fit edge to edge.

33. To allow the new panel to fit along the floor plan and rocker panel, remove all excess metal left from cuts.

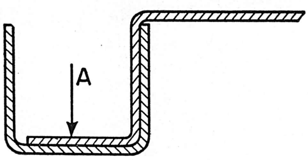

Fig. 7-15.

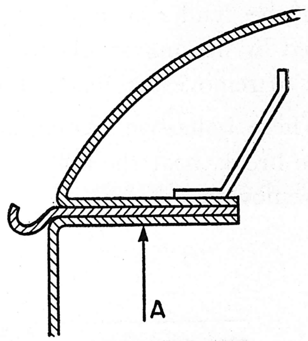

Fig. 7-16.

Installing Rear-quarter Panel Assembly

After the damaged rear-quarter panel has been carefully removed and the edges prepared, the new panel should fit. Careful checking at this point will save time afterward.

Be sure that the new panel fits into the opening at *all* points of contact. Then follow carefully the procedure given.

Tools and Equipment

Welding outfit; No. 2 tip; welding clamps; hydraulic jack; socket wrenches; screw drivers; aviation snips; ball-peen hammer; 6-in. C clamps; Vise-Grip wrenches; disk sander; safety goggles; soldering kit.

Materials

New quarter panel; $\frac{3}{32}$-in mild-steel welding rod; No. 36 closed-coat disk; body solder; bronze welding rods; brazing flux; asbestos paper; primer; body deadener.

Procedure

1. Extend a jack slightly to make positioning of the new panel easier (*H,* Fig. 7-17).

2. Place 6-in. clamps at points *B,* Fig. 7-17.

3. Place a Vise-Grip wrench at the inside roof railing (*A,* Fig. 7-18).

4. Place Vise-Grip wrenches at the lower

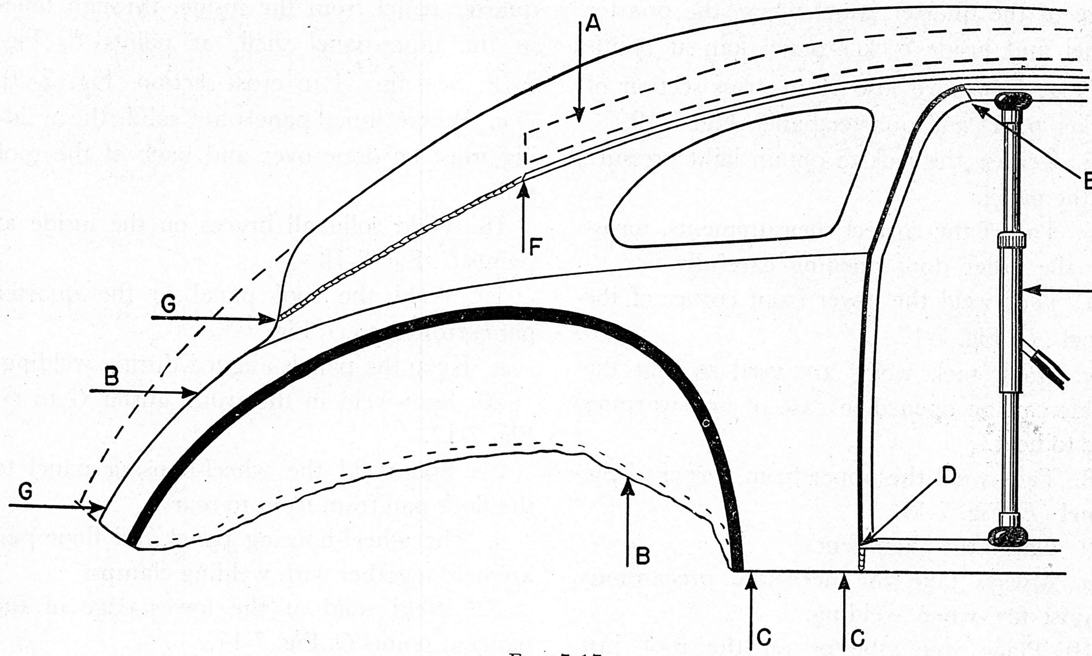

FIG. 7-17.

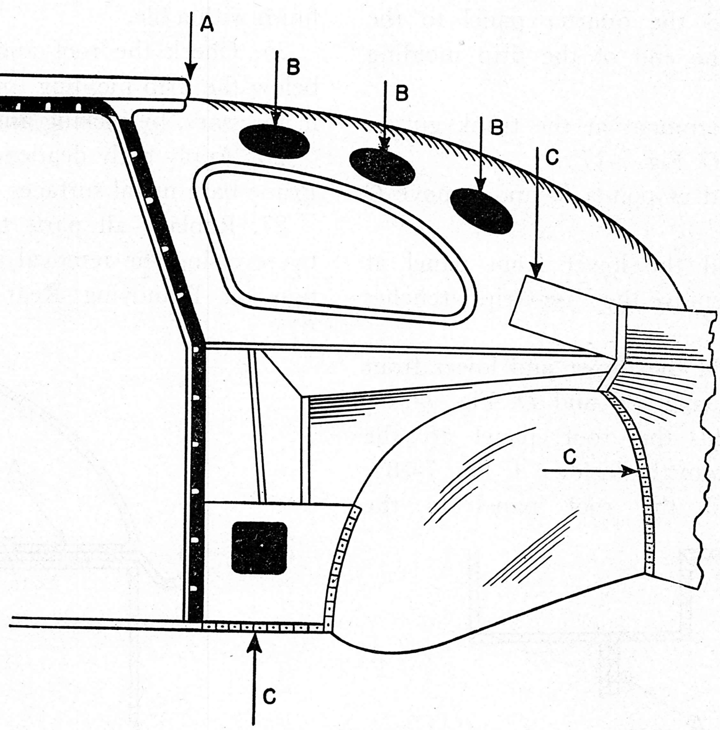

FIG. 7-18.

edge of the quarter panel where the quarter panel and inside rocker panel join at points *C*, Fig. 7-17. See also *A* in cross section of rocker panel and quarter panel, Fig. 7-19.

5. Release the jack to obtain light pressure on the panel.

6. To get the correct measurements, measure the other door opening carefully.

7. Tack-weld the lower front corner of the panel (*D*, Fig. 7-17).

a. Small tack welds are used so that the welds can be opened in case of any warping due to heat.

8. Tack-weld the upper front corner of the panel (*E*, Fig. 7-17).

9. Check the alignment.

a. Always take the necessary precautions against fire when welding.

10. Place wet asbestos on the roof just above the drip molding (*A*, Fig. 7-17).

a. Wet asbestos paper keeps the paint from being scorched and prevents warping.

11. Tack-weld the quarter panel to the roof panel at the end of the drip molding (*F*, Fig. 7-17).

12. Check alignment at the trunk gutter, and tack-weld (*G*, Fig. 7-17).

13. Tack-weld at points *B*, and remove *C* clamps (Fig. 7-17).

14. Tack-weld the lower front panel at points *C*, and remove the Vise-Grip wrenches (Fig. 7-17).

15. Weld solid the upper and lower front corners of the panel (*E* and *D*, Fig. 7-17).

16. Tack-weld the roof panel to the quarter panel from the inside (*A*, Fig. 7-18).

17. Tack-weld the roof panel to the quarter panel from the inside, through holes in the inner-panel shell, at points *B*, Fig. 7-18. See also *A* in cross section, Fig. 7-20.

a. Where inner panels are solid, the welding must be done over and back of the roof rail.

18. Weld solid all braces on the inside at points *C*, Fig. 7-18.

19. Weld the roof panel to the quarter panel from *F* to *G*, Fig. 7-17.

a. Keep the panels aligned during welding.

20. Spot-weld in the trunk gutter *G* to *G*, Fig. 7-17.

21. Spot-weld the wheel-housing panel to the floor pan from front to rear.

a. The wheel-housing panel and floor pan are held together with welding clamps.

22. Weld solid at the lower edge of the panel at points *C*, Fig. 7-17.

23. Smooth the welds at points *D*, *E*, and *F* with a No. 36 closed-coat disk (Fig. 7-17).

24. Solder the welds just smoothed, and finish with a file.

25. Check the roof and panel above and below the drip molding for warp. Straighten, if necessary, by picking and filing.

26. Apply body deadener where necessary. Prime bare metal surfaces on the inside.

27. Replace all parts that were removed by reversing the removal procedure (see section on Removing Rear-quarter Panel, p. 97).

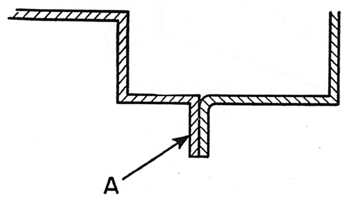

Fig. 7-19.

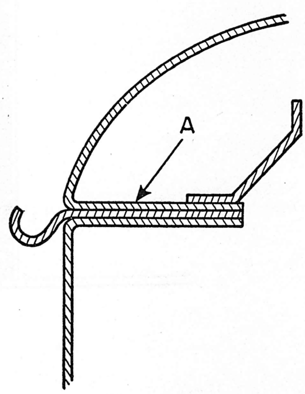

Fig. 7-20.

Installing a Door-repair Panel

On many door damages the upper part is intact; the door frame is not beyond repair, but the lower outer panel is too badly damaged for repair. In such cases, a new door-repair panel can be installed. Door-repair panels are available for most makes and models. Panels that are not available can be made from 20-gauge cold-rolled sheet metal. Door-repair panels are not difficult to replace when the correct sequence of operations is followed.

Tools and Equipment

Welding outfit; No. 1 tip; sheet-metal chisel; disk sander; safety goggles; ball-peen hammer dinging hammer; toe dolly; socket wrenches; screw drivers; soldering kit; ¼-in. electric drill; ⅛-in. twist drill; hack saw; body file; welding clamps; aviation snips; scratch awl.

Materials

New door-repair panel; 14-oz. tinners' rivets; body solder; No. 36 open-coat disk; No. 36 closed-coat disk; weatherstrip cement; primer.

Procedure

1. Remove the door handle, door-lock cylinder, upholstery, glass, and weather stripping.

a. Regulators and door latch assemblies need not be removed.

2. Cut flanges at points *A,* Fig. 7-21, with a hack saw.

3. Scribe a line ¾-in. below the belt line from *A* to *A,* as shown in Fig. 7-21, and *A* in cross section, Fig. 7-22.

4. Cut a panel 1¼ in. below belt line or ½ in. below the line just scribed, using a sheet-metal chisel.

a. The ½ in. is allowed for trimming to make a smooth, straight edge.

5. Use a No. 36 closed-coat disk to sand through the edge of the outer door-panel flange to separate the outer panel from the inner panel (*B,* Fig. 7-21).

a. Be careful not to sand into the inner panel flange.

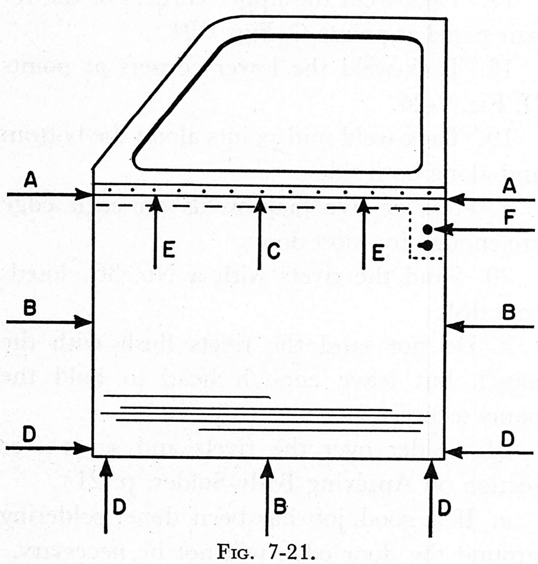

Fig. 7-21.

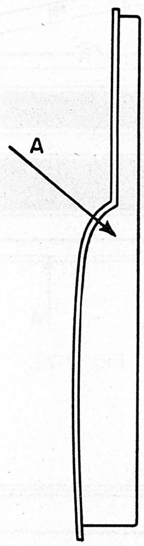

Fig. 7-22.

b. Hold the sander as shown in Fig. 7-23, to avoid gouging and tearing the disk. A torn disk may cause injury to the operator.

6. Remove the strips left around the door flange (*A,* Fig. 7-24).

a. Using pliers, begin at one end and roll the strip around the pliers the spot welds will break.

7. Straighten the flange of the inner panel where necessary.

8. Trim the top edge along the line scribed, leaving ¾ in. for overlap.

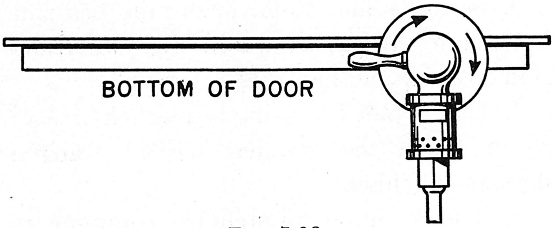

FIG. 7-23.

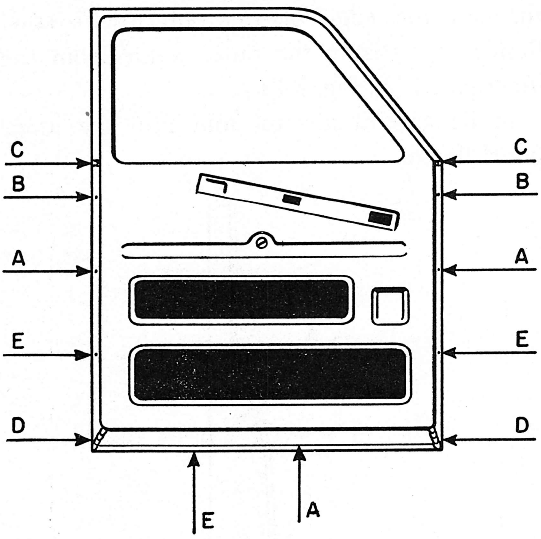

FIG. 7-24.

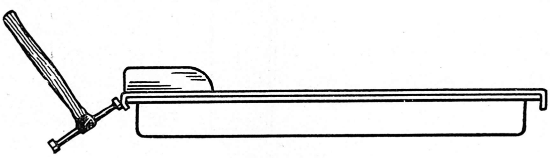

FIG. 7-25.

9. Slide the new repair panel under ¾ in. of the upper panel, and check for fit.

a. If the repair panel is too long, trim it at the top.

10. Attach welding clamps to hold the inner and outer panels together at point *B,* Fig. 7-24.

11. Position the repair panel until the contour is correct at the upper seam; then drill a ⅛-in. hole in the center and insert a 14-oz. rivet (*C,* Fig. 7-21).

a. Insert the rivet from the inside, and peen the rivet while backing it up with a dolly.

12. Roll a flange at the corners (*D,* 7-21).

a. See crosscut of door in Fig. 7-25.

13. Complete rolling the flange all around the repair panel.

a. Note the position of the dolly when rolling the flange (Fig. 7-25).

14. Drill holes and insert rivets at points *E,* Fig. 7-21.

15. Continue inserting rivets at mid-points until they are 1½ in. apart.

16. Remove a strip of paint 2 in. wide above the repair panel with a No. 36 open-coat disk.

17. Tack-weld the upper corners of the repair panel at points *C,* Fig. 7-24.

18. Tack-weld the lower corners at points *D,* Fig. 7-24.

19. Tack-weld mid-points along the bottom and along both sides.

a. Four or five tack welds on each edge are enough for most doors.

20. Sand the rivets with a No. 36 closed-coat disk.

a. Do not sand the rivets flush with the panel, but leave enough head to hold the panel securely.

21. Solder over the rivets and seam (see section on Applying Body Solder, p. 21).

a. If a good job has been done, soldering around the door edge will not be necessary.

22. Smooth the solder with a body file.

23. Clean and prime the flange where the welding was done at points *E,* Fig. 7-24.

24. Cut a corner from the old panel, and use a template to locate holes for the door handle and the door-lock cylinder.

25. Drill holes for the door handle and the door-lock cylinder (*F,* Fig. 7-21).

26. Replace all parts removed except the door handle and the door-lock cylinder.

a. The door handle and door-lock cylinder should be replaced after the door is painted.

Removing a Top Panel

Before starting to remove the old top panel, the body mechanic must examine the new top panel he is about to install to make sure that it is the right one for the car that is to be repaired. Some top panels are interchangeable on cars built by the same manufacturer.

The body must be carefully measured and cross-checked, to make sure that it is squared up; the templates must be accurate if short cuts are used; the roof rails must be in alignment.

The removing of the old top panel is as important as the installing of the new top panel.

The following procedure is approximately the same on most makes of cars.

Tools and Equipment

Welding outfit; No. 1 tip; No. 2 tip; disk sander; safety goggles; ¼-in. electric drill; 3⁄16-in. twist drill; socket set; screw drivers; aviation snips; sheet-metal chisel; cold chisel; Vise-Grip wrench; ball-peen hammer; dinging hammer; all-purpose dolly; toe dolly; tack hammer; ripping tool; wire brush; center punch.

Materials

New top panel; 3⁄16-in. mild-steel welding rod; cardboard for templates; No. 36 closed-coat disk.

Procedure

1. Remove the seats and the rear shelf.
2. Remove the garnish moldings.
3. Remove the rear-quarter windows.
4. Remove the windshield and rear glass.
5. Remove the sun visors.
6. Remove the upholstery on the door post and rear-quarter panels.
7. Remove the dome light and switch.
8. Disconnect the battery and remove wiring.
9. Remove the headlining (see section on Removing Upholstery, p. 129).
10. Remove the trunk lid and the gutter rubber.
11. Square up the body with a hydraulic jack before removing the top panel (*E,* Fig. 7-26).
12. Study the damage to the old top panel, and consider all short cuts that can be used.

a. When the panel between the rear window and trunk lid is not damaged, the top panel can be cut at the side center of the rear window (*A,* Fig. 7-26).

b. When the new top panel and the upper cowl panel are in one assembly, and the cowl panel on the car is not damaged, cut top panel at the center of both windshield posts (*B,* Fig. 7-26).

c. When one or both of the short cuts are used, make templates (see section on Template Making, p. 37).

13. Heat the areas with a torch to remove the solder from the welds at points *C,* Fig. 7-26.

a. Use a wire brush to clean solder from the welds while heating the solder.

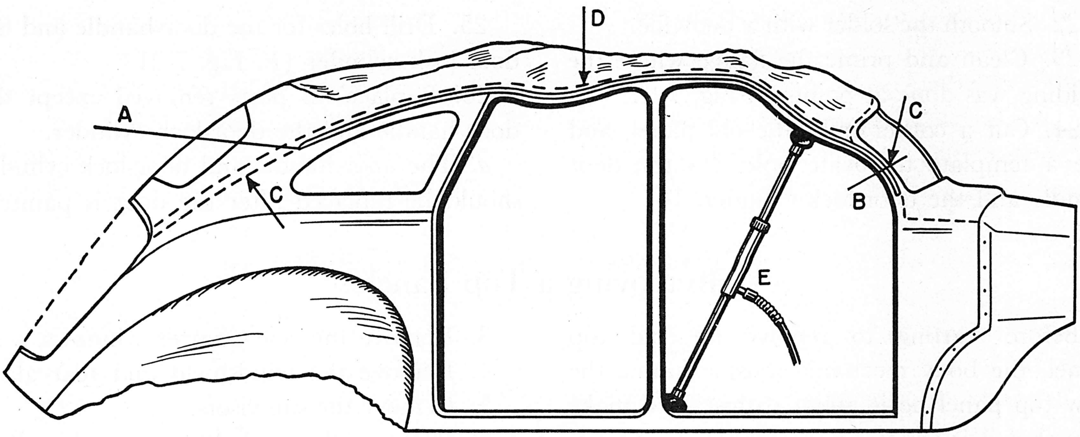

Fig. 7-26.

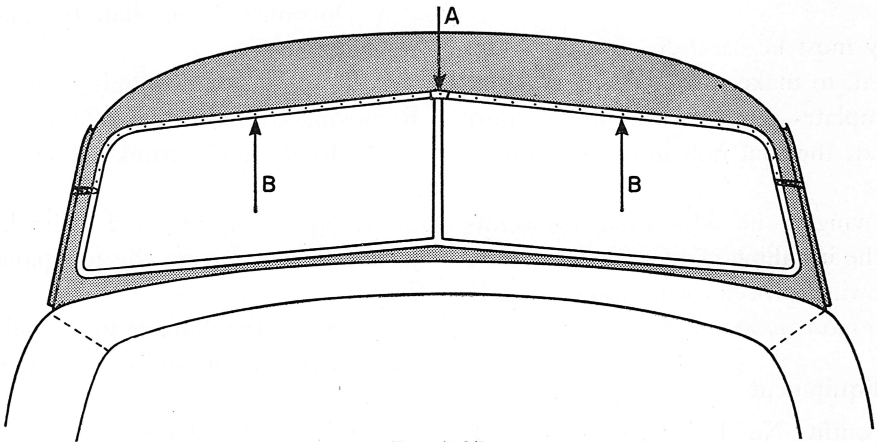

Fig. 7-27.

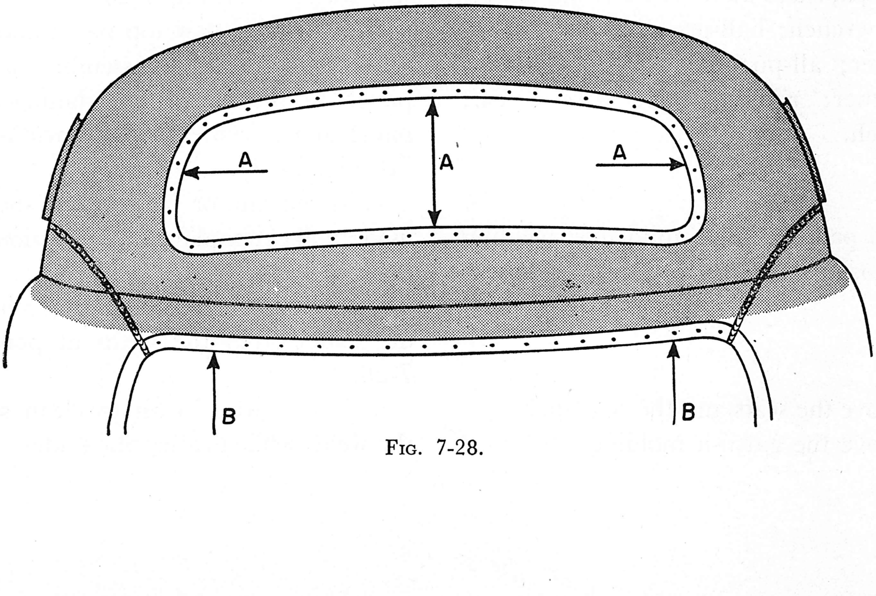

Fig. 7-28.

14. Cut the top panel just above the weld at points *C,* Fig. 7-26.

a. Use a hack saw to cut the top panel on the windshield post and a sheet-metal chisel to cut the top panel from the drip molding to the rear window.

15. Cut the top panel ½ in. above the drip molding along both sides as indicated by the dotted line *D,* Fig. 7-26.

16. Cut the panel ½ in. above the windshield (*A,* Fig. 7-27).

17. Drill spot welds around the rear window at points *A,* Fig. 7-28.

18. Drill spot welds in the trunk gutter at points *B,* Fig. 7-28.

19. Remove the old top.

20. Remove all deadening material from the roof rails.

a. Spot welds cannot be located before removing deadening material.

21. Locate spot welds and drill.

a. Drill from above.

22. Remove the remaining strip of the old top from the roof rails.

23. Drill the spot welds in the upper part of windshield opening, and remove the balance of the old top at points *B,* Fig. 7-27.

24. Straighten and line up the windshield reinforcement, roof rails, and rear window.

25. Smooth the roof rails, windshield opening, rear-window opening, and trunk gutter.

26. Cut the stationary bows with a hack saw (Fig. 7-29).

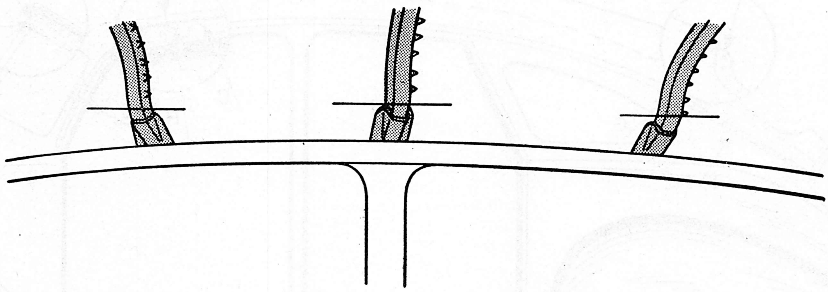

Fig. 7-29.

Installing a New Top Panel

Before beginning the installation of the new top panel, the body mechanic must cross-check the body of the car from side to side and compare the door openings of one side with the door openings of the other side. The new top panel will fit if the body is not squared up.

Remove all rust-preventive coating and prime the new top panel.

Tools and Equipment

Welding outfit; No. 1 tip; No. 2 tip; disk sander; safety goggles; socket set; screw drivers; Vise-Grip wrench; 6-in. C clamps; soldering kit; headlining tool; tack hammer; welding clamps.

Materials

New top panel; 1/16-in. mild-steel welding rod; body solder; asbestos paper; templates; No. 2 upholstery tacks; No. 4 upholstery tacks; trim cement; weather-strip cement; No. 36 open-coat disk; No. 36 closed-coat disk; 3/32-in. bronze welding rod; brazing flux; deadening material; primer.

Procedure

1. Lay the new top panel on the car, and

check all around to see that the top fits.

a. If the new top panel has a rust-preventive coating, remove the coating and prime the panel before installing.

b. Make sure that the corners at the windshield posts and trunk gutters are not too high or too low.

c. If the new top does not fit at all points, the body must be lined up.

2. Place a Vise-Grip wrench at *A* and *B,* Fig. 7-30.

3. Place 6-in. C clamps at *C* and *D,* Fig. 7-30.

a. The top should now line up perfectly.

4. Check the windshield openings with the windshield glass.

a. The glass must have the same clearance all around and must touch the flanges at all points.

5. Tack-weld at *E* on both sides of the top panel (Fig. 7-30).

6. Tack-weld at the center of the windshield (*F,* Fig. 7-30).

7. Tack-weld at the center of the rear window (*B,* Fig. 7-30.)

8. Tack-weld in the trunk gutter (*D,* Fig. 7-30).

9. Tack-weld at the drip molding on both sides (*G,* Fig. 7-30).

10. Place wet asbestos on the top panel above the weld to keep the panel from warping.

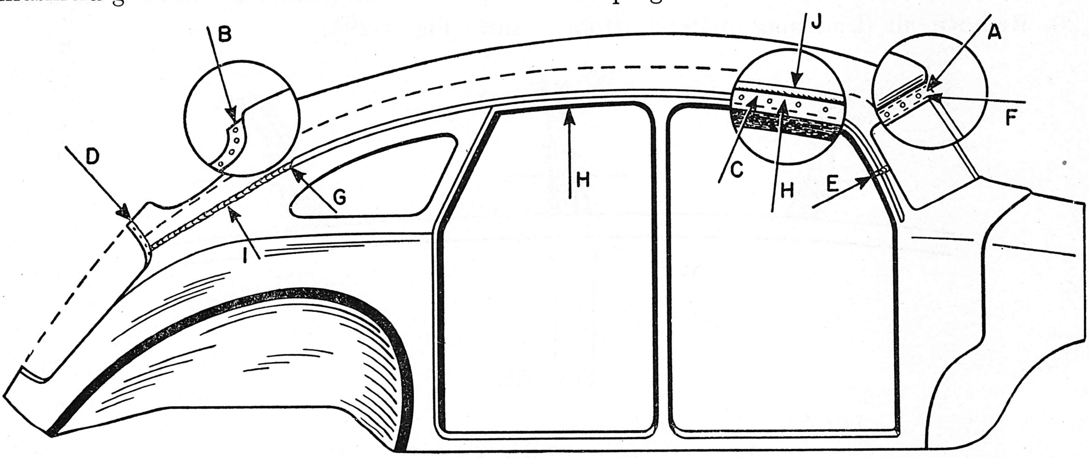

Fig. 7-30.

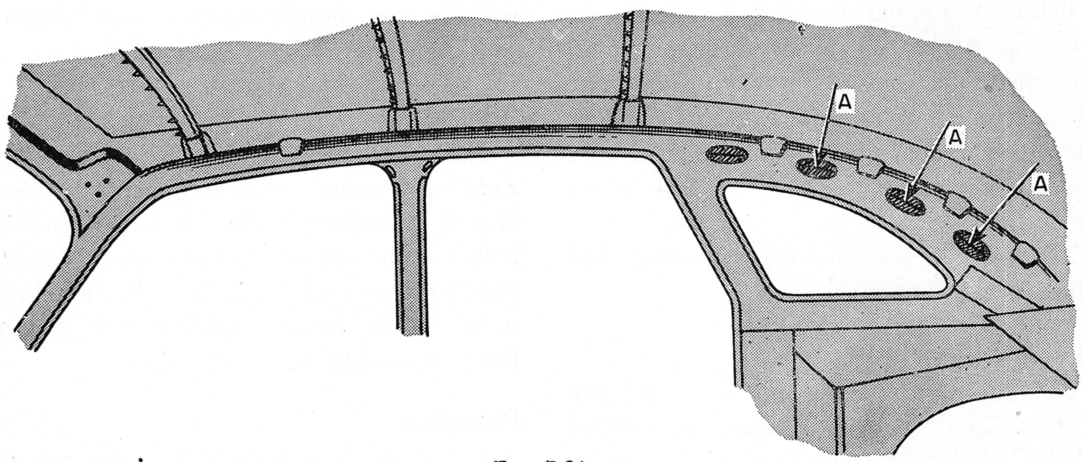

Fig. 7-31.

11. Place a Vise-Grip wrench at the points *A*, Fig. 7-31, and tack-weld.

a. Make sure that the top panel and the rear-quarter panel are close together above the rear-quarter window.

12. Drill 3/16-in. holes in the top panel at the top of the front door frames on both sides, and spot-weld (*H*, Fig. 7-30. See also Procedure 6, Spot Welding, in the section on Welding Sheet Metal, p. 13).

13. Drill 3/16-in. holes around the upper windshield and the rear-window openings, and spot-weld.

14. Tack-weld and then weld solid at *I*, Fig. 7-30.

15. Spot-weld in the trunk gutter, holding the panel in place with welding clamps.

a. Alternate the welds from side to side to keep the panel in line.

16. Tack-weld the top to the quarter panel from the inside (*A*, Fig. 7-31).

a. Alternate the welds from side to side and from front to rear to keep expansion even.

17. Weld the windshield posts (*E*, Fig. 7-30).

a. On some cars, the front end of the drip molding is separate. In that case, install the drip molding with spot welds before soldering (*J*, Fig. 7-30).

18. Smooth the welds with a No. 36 closed-up disk.

a. If the top is warped, straighten it.

19. Solder where necessary.

a. No soldering will be necessary if spot welds are properly done.

20. Smooth the soldered areas with a body file.

21. Prime inside and around the rear window, windshield, and trunk gutter where welding was done.

22. Install the rear window and the windshield.

23. Glue body-deadening material on the inside where the top panel meets the roof rails.

a. Some panels have the deadening material already installed.

24. Straighten and fit stationary bows to the roof panel and weld them in place.

25. Replace wiring.

a. Be sure wiring is correct and all lights properly grounded.

b. Connect the battery cable, and try lights and switches before installing the headlining.

26. Install the trunk-gutter rubber and the trunk lid.

a. Coat the trunk gutter and rubber with weather-strip cement, and allow it to get tacky before installing the rubber.

27. Replace all parts that were removed by reversing the removal procedure. (see section on Removing a Top Panel, p. 105).

Questions

1. What are two types of trunk panels in general use?
2. Why are small grooves at both sides of a trunk?
3. When cutting double-thickness sheet metal, how can only one thickness be cut?
4. Why should tack welds in a rocker panel be small?
5. When replacing a cowl assembly, what short cut can be taken to avoid removal of steering-gear assembly?
6. What two measurements are needed before a new cowl is welded into place?
7. In what two ways is headlining attached?
8. How is a roof panel treated to prevent warping when welding a center pillar into position?
9. How can fender bolts be removed quickly when the car has been undercoated?
10. How are spot welds along the roof rail opened? Why?
11. When positioning a new quarter panel, what type of welds are used and why?
12. How much metal is left in a new door panel for trimming?
13. What checks should be made before removing a damaged top panel?
14. Why should body lights be tested before installing headlining?

CHAPTER 8

Painting Equipment and Techniques

Air Requirements of Painting Equipment

Painting equipment is generally considered to consist of an air compressor, spray gun, air hose, combination water and oil extractor combined with an air pressure regulator, respirator, and a spray booth.

The following figures show typical air requirement needs of shop equipment. The total in free air consumption of all equipment used in the shop should not exceed the capacity of the compressor and, if possible, should be about 25 per cent less.

Equipment air pressure range, lb. per sq. in.	*Type equipment*	*Average free air consumed, cu. ft. per min.*
70–100	Body sander	5.0
120–150	High-pressure grease gun	3.0
70–100	Fender hammer	8.75
145–175	Hydraulic lift	5.25
50–100	Production spray gun	8.5
50–100	Touch-up spray gun	2.25
70–100	Undercoating spray gun	19.0
120–150	Tire inflation line	1.5

Figure 8-1 illustrates a stationary two-cylinder piston-type compressor and air tank. Units such as this are available in a wide variety of sizes and pressures. Selection of the proper size unit is of great importance because air is used in many ways within the shop other than in painting.

Figure 8-2 illustrates a typical portable compressor for light-duty work.

Figure 8-3 illustrates a typical combination water and oil extractor combined with a pressure regulator valve. Condensation forms in air lines and air tanks and must be re-

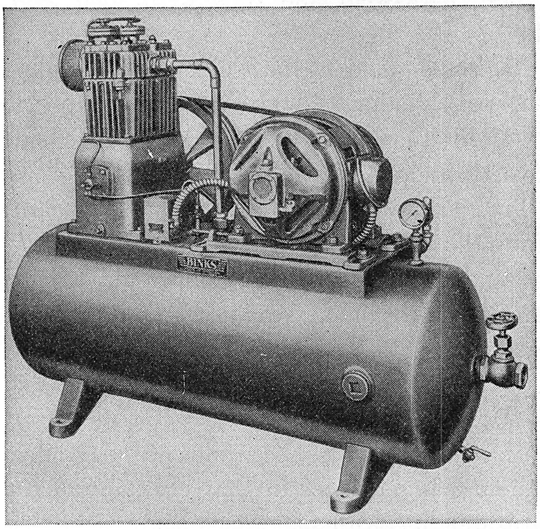

Fig. 8-1.

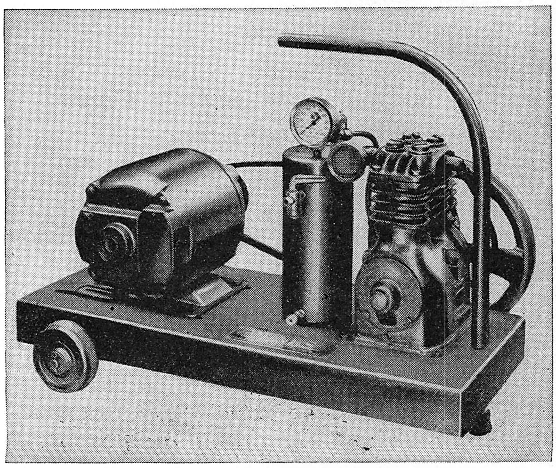

Fig. 8-2.

moved before the air enters the spray gun. Line air pressure is too high to ensure satisfactory paint spraying; therefore it is necessary to include a device to regulate the line pressure to the desired spraying pressure. One gauge shows line pressure; the other, spraying pressure.

Figure 8-4 illustrates a popular type of production spray gun (left) equipped with a cup, cover, and hose. The smaller spray gun (right) is used for painting small spots and areas.

Figure 8-5, sectioned view of production external-mix spray gun shows *A,* air seal between air cap and gun body; *B,* side port air-control needle; *C,* spring-load mechanism to fluid-control valve; *D,* spray-gun handle and body; *E,* fluid- or paint-material nozzle;

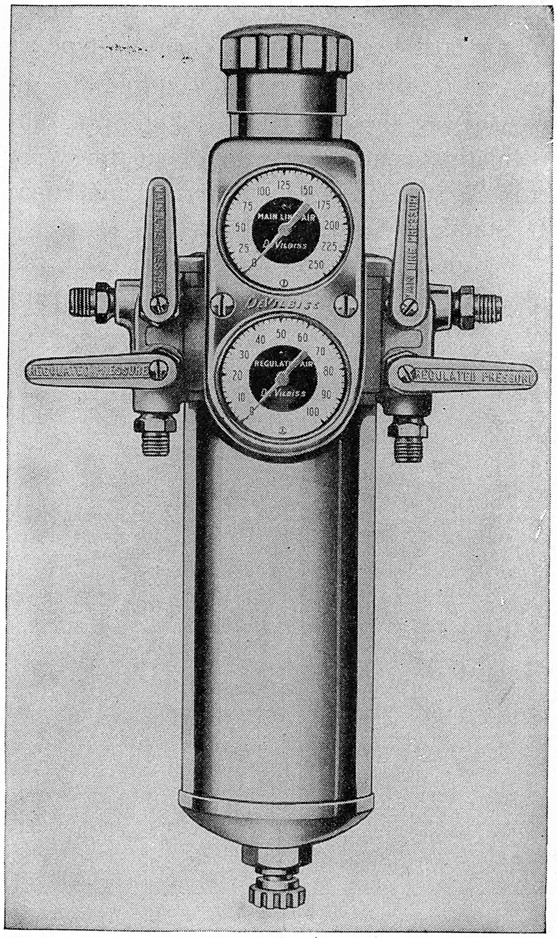

Fig. 8-3.

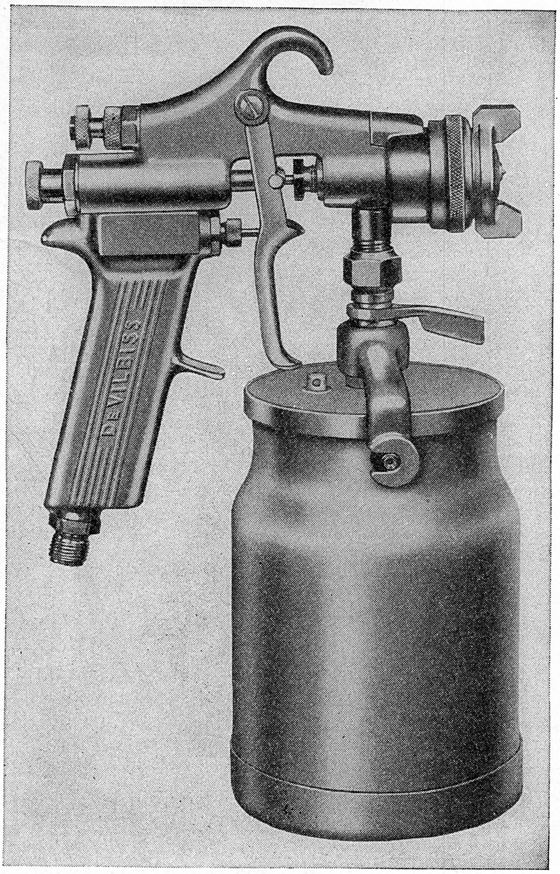

Fig. 8-4 (left).

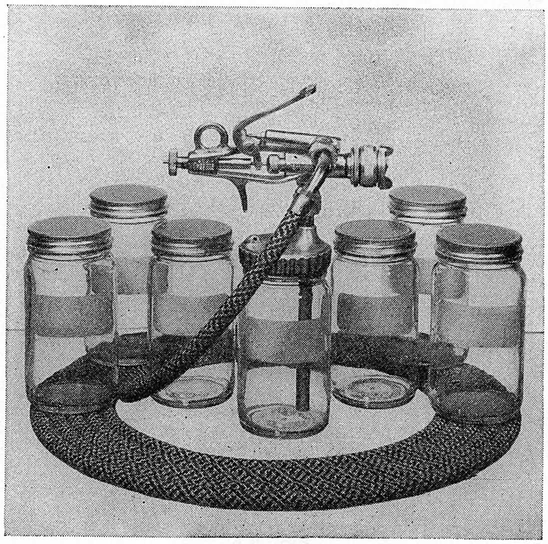

Fig. 8-4 (right).

F, fluid-control nozzle; *G,* spray-gun head; *H,* air nozzle or air cap; *I,* cartridge-type air valve; *J,* air-valve trigger control; *K,* air passageway through handle of gun; *L,* air-regulating control; *M,* fluid-regulating control; *N,* standard ⅜-in. material connection; *O,* standard ¼-in. air connection.

Figure 8-6 illustrates a twin-cartridge respirator. Air is breathed in through the cartridges *A* and out through the center valve *B*. The cartrides are replaceable and contain treated charcoal which filters paint spray and fumes from the air. The life of cartridges can be prolonged if they are covered with paper filters held in place by metal clips. The respirator can be sterilized by dipping it into denatured alcohol and allowing it to dry before reusing.

Figure 8-7 illustrates a hood-type respirator which is commonly used in areas of poor ventilation such as the inside of panel trucks or semitrailers. An air line from the hood is attached to the shop air line; and, using a

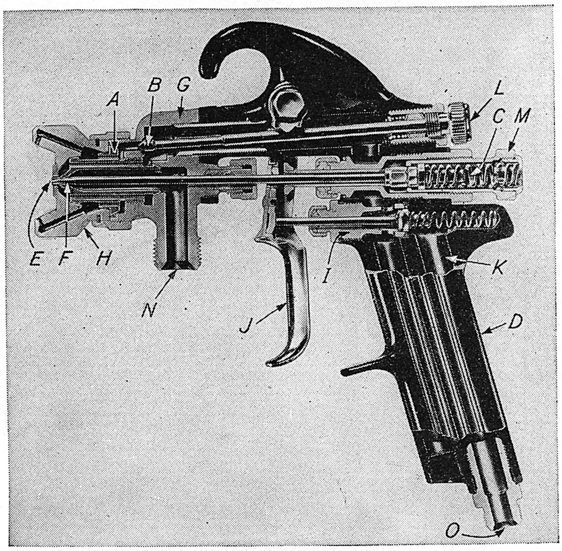

Fig. 8-5.

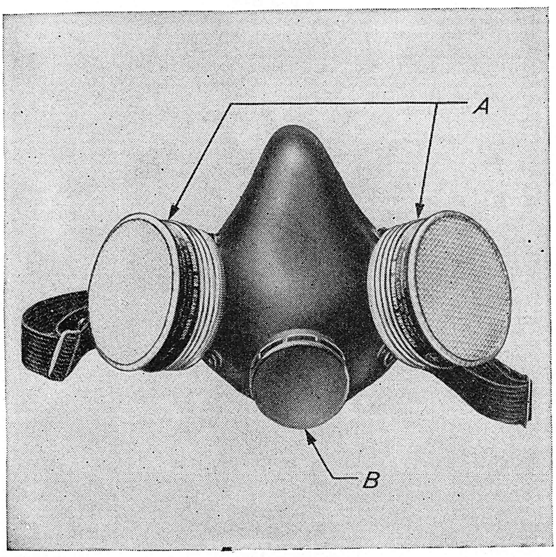

Fig. 8-6.

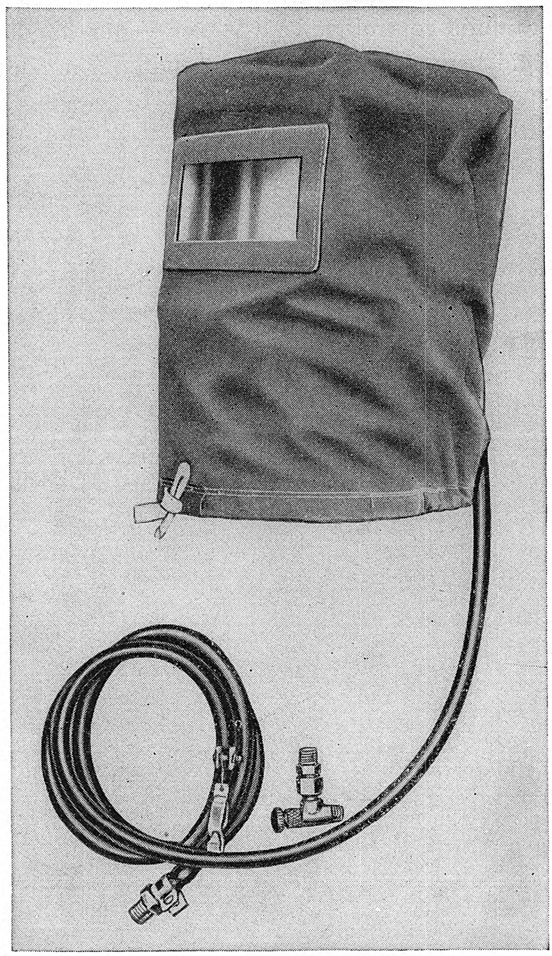
Fig. 8-7.

regulator valve, the painter can regulate the amount of air coming into the top of the hood.

Figure 8-8 illustrates a self-contained spray booth for shops or schools where it is found desirable to refinish cars under the observation of spectators. Air enters the booth through large filters in the door and is exhausted by a fan in the top; then it passes to the outside of the building.

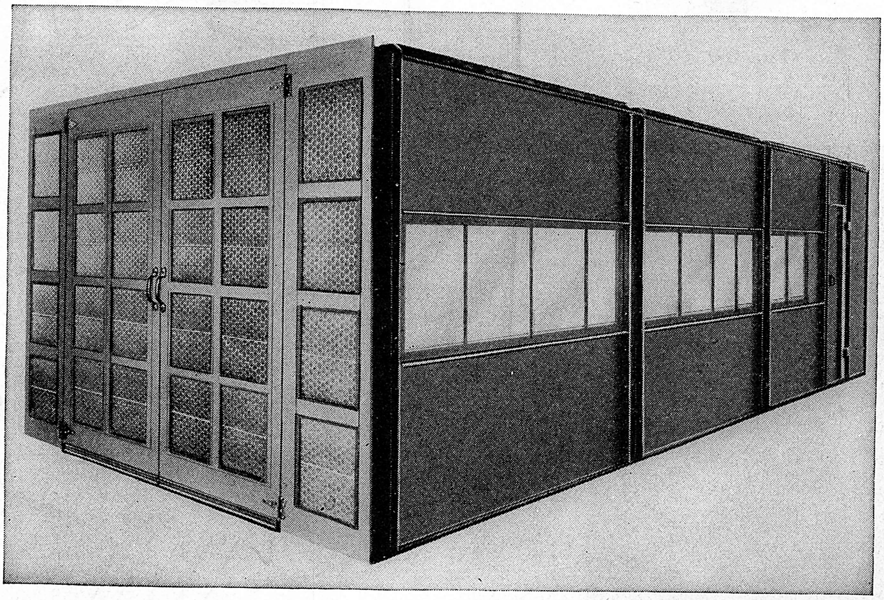

FIG. 8-8.

Types of Spray Patterns

Production spray guns are ruggedly constructed but, being precision tools, require some necessary maintenance and care. To handle a spray gun properly requires a knowledge of its construction, maintenance, and operation.

Correct Spray Patterns

In normal operation (Fig. 8-9), the tips or wings on the nozzle are in a horizontal position, which produces a vertical spray pattern and assures maximum coverage as the gun is moved back and forth *parallel* to the work and held about 6 to 8 in. from it (Fig. 8-10).

The spray pattern can generally be varied from round to elliptic or almost flat, as shown in Fig. 8-11.

It is possible and necessary to regulate both air and fluid flow within the gun, as illustrated in Fig. 8-12. The upper control *A* regulates the width of the spray. A turn to the right will produce a round pattern, while a turn to the left will produce a fan pattern. The lower control *B* controls the fluid or paint. A turn to the right decreases the flow, while a turn to the left increases the flow. It will be necessary to regulate both the pattern and fluid-control screws in conjunction, since the change in spray pattern will require more fluid when wide and less when narrow. As width of spray is increased, more fluid or paint must be permitted to pass through the gun to obtain the same coverage on the increased area being sprayed.

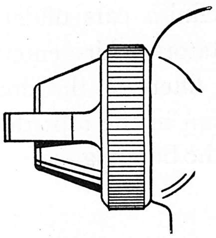

FIG. 8-9.

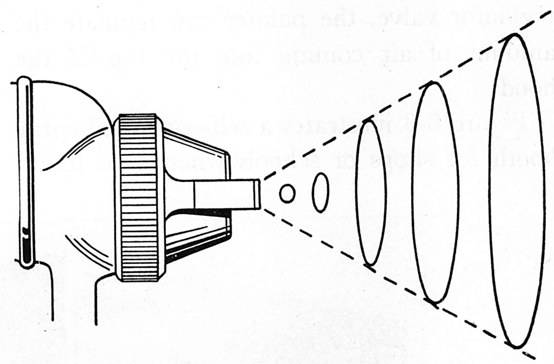

FIG. 8-11.

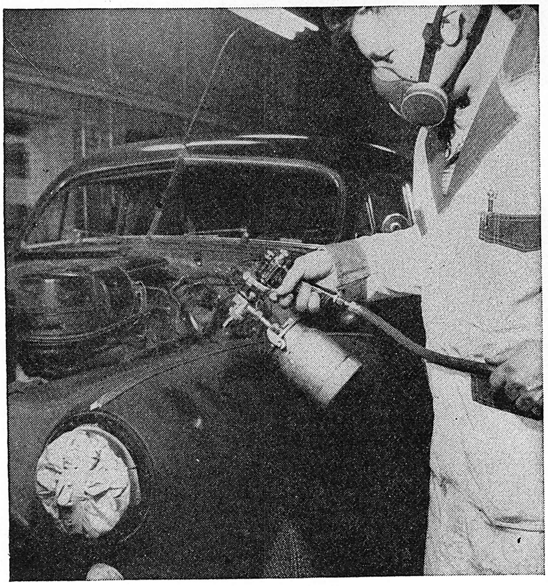

FIG. 8-10.

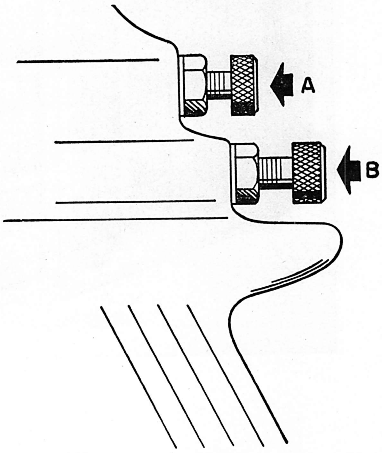

FIG. 8-12.

Faulty Spray Patterns and Their Correction

Faulty pattern (Fig. 8-13):
Cause: Dried or foreign material in side port *A* (Fig. 8-14), restricts passage of air through it, thereby sending full air pressure through the clean side port *toward* the clogged side.
Correction: Dissolve material in the side port with thinner. *Never* force any fine object which would enlarge the hole into the opening.

Faulty pattern (Fig. 8-15):
Cause: Dried material around the outside of the fluid-nozzle tip at position *B* (Fig. 8-16) restricts the passage of atomizing air at one point through the center opening of the air nozzle and results in the pattern shown. This pattern can also be caused by a loose air nozzle.
Correction: If dried material is causing the trouble, remove the air nozzle and wipe the fluid tip, using a rag wet with thinner. Tighten the air nozzle.

Faulty pattern (Fig. 8-17):
Cause: A split spray or one that is heavy on each end of a fan pattern and weak in the middle is usually caused by (1) too high an atomizing air pressure or (2) by attempting to get too wide a spray with thin material.
Correction: Reducing the air pressure will correct *cause* (1). To correct *cause* (2), open material control *D* to full position by

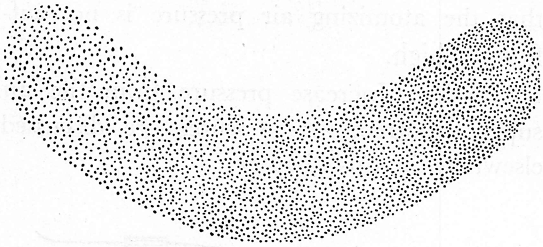

Fig. 8-13.

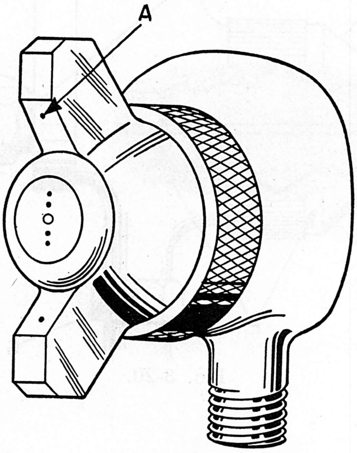

Fig. 8-14.

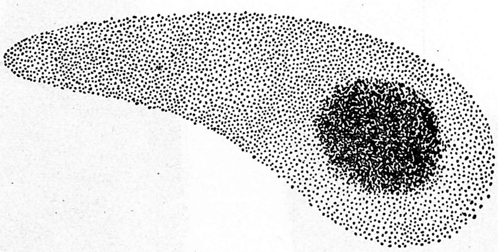

Fig. 8-15.

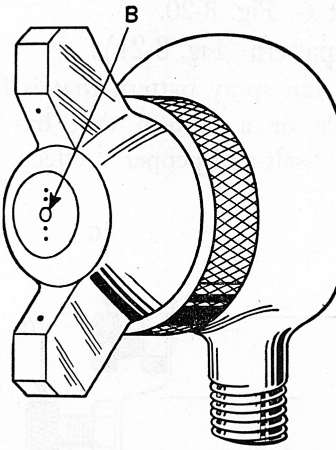

Fig. 8-16.

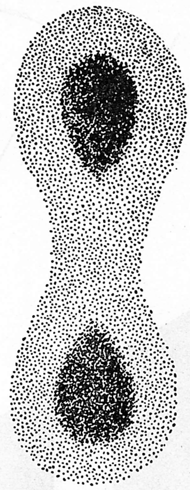

Fig. 8-17.

turning it to the left. At the same time, turn spray-width adjustment *C* to the right (Fig. 8-18). This will reduce the width of the spray, but it will correct a split spray pattern.

Spitting pattern (Fig. 8-19):

Cause: 1. Dried-out packing around a material-needle valve permits air to get into the fluid passageway. This results in spitting.

2. Dirt between the fluid-nozzle seat and body or a loosely installed fluid nozzle will make a gun spit.

3. A loose or defective swivel nut on the siphon cup or material hose can cause spitting.

Correction: To correct *cause* 1, back up the knurled nut (*E,* Fig. 8-20), place two drops of machine oil on the packing, replace the nut, and tighten it with fingers only. In aggravated cases, replace the packing.

To correct *cause* 2, remove the fluid nozzle *F,* Fig. 8-20; clean the back of the nozzle and the nozzle seat in the gun body, using a rag wet with thinner; replace the nozzle, and draw it up tightly against the body.

To correct *cause* 3, tighten or replace the

swivel nut *G,* Fig. 8-20.

Faulty pattern (Fig. 8-21):
Cause: A fan spray pattern that is heavy in the middle or a pattern that has an un-atomized "salt-and-pepper" effect indicate that the atomizing air pressure is not sufficiently high.
Correction: Increase pressure from the air supply. Correct air pressures are discussed elsewhere in this chapter.

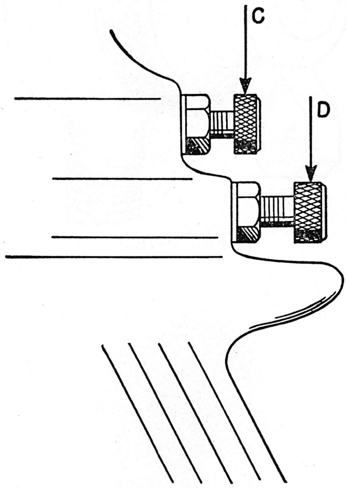

FIG. 8-18.

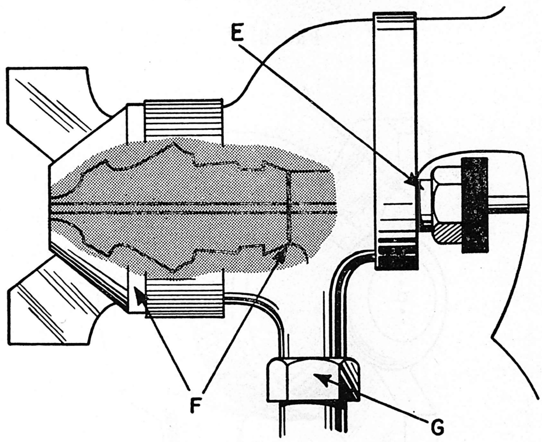

FIG. 8-20.

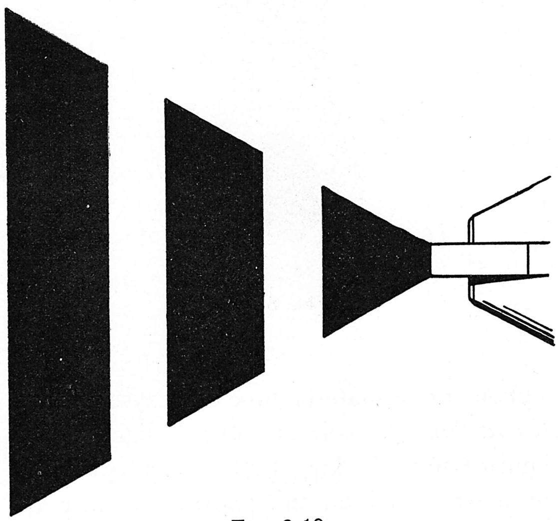

FIG. 8-19.

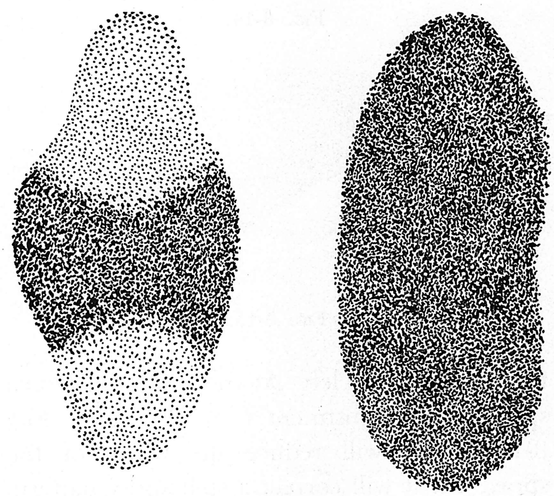

FIG. 8-21.

Spray Gun Care and Operation

Cleaning the Paint Gun

When the gun is used with a cup, thinner or suitable solvent should be siphoned through the gun by inserting the tube in an open container of that liquid. Move the trigger constantly to flush the passageway thoroughly and to clean the tip of the needle.

When the gun is used with a pressure tank or a gravity bucket, remove the hose, turn the gun upside down, and pour thinner into the fluid opening while moving the trigger constantly. This will flush all passageways.

When using the same color repeatedly, the nozzle assembly should be removed and cleaned separately in the solvent and replaced, but the entire unit should be cleaned at the end of the day.

It is extremely poor practice to place an entire gun in thinner. When this is done, the solvent dissolves the oil in the leather packing and causes the gun to spit.

It is good practice to place the nozzle and fluid connection in thinner. Vessel used should be shallow enough to prevent thinner from reaching packing.

Air Pressures

"Air pressure" is pressure at the gun with the gun open. Atomizing pressure must be set to allow for the drop in air pressure between the regulator and the spray gun. When using a siphon cup, set the pressure at the gun (with trigger pulled) at not over 50 lb. for lacquer and 60 lb. for synthetic enamel. Twenty-five feet of ¼-in. inside-diameter (I.D.) hose causes a drop of 16 lb. between the air supply and the gun. Twenty-five of 5⁄16-in. I.D. hose has a drop of only 5 lb. For this reason, 5⁄16-in. hose is recommended.

Importance of Extractors

An oil and water extractor serves a double purpose. It eliminates blistering and spotting by keeping air free from oil and water, and its precision air regulator makes possible perfect air-pressure control at the gun. The best spray gun in the world will not operate efficiently without a good compressor and a good oil and water extractor. It is impossible to get a fine finish without the use of an oil and water extractor.

The oil and water extractor should be at least 25 ft. from the air compressor and further if possible. The temperature of the air is greatly increased as it passes through the compressor, and this compressed air must be cooled before the moisture in it will condense. If the air from the compressor is still warm when it passes through the oil and water extractor, moisture will not be effectively removed but will remain in suspension. Then, when the air cools in the hose beyond the extractor, the moisture will condense into drops of water and cause trouble.

Sanding

Sanding is most important in refinishing. Paint will magnify all surface imperfections; therefore the surface must be smooth to produce a smooth finish when paint is applied.

Two types of sandpaper are in general use, dry sandpaper and wet or dry sandpaper. The grit material on the dry sandpaper is aluminum oxide. Dry sandpaper is used for featheredging, sanding rusty spots, and for sanding glazing putty. "Featheredging" means the tapering off of the old paint for 1 in. or more surrounding a bare spot, so that there will be no noticeable "step" between the old paint and the bare surface.

The grit in wet or dry sandpaper is silicon carbon. Use with water lengthens the life of the paper, aids in producing a smoother finish, and helps to keep the grit from clogging.

Sanding Blocks

On large, even surfaces, sanding is done with a sanding block (Fig. 8-22), on which sandpaper is attached and held while sand-

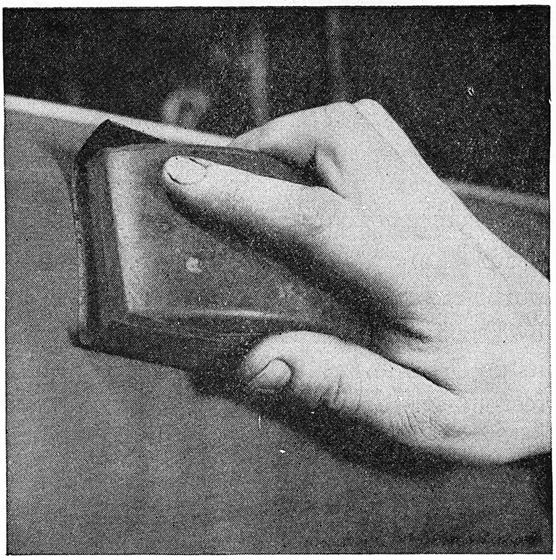

Fig. 8-22.

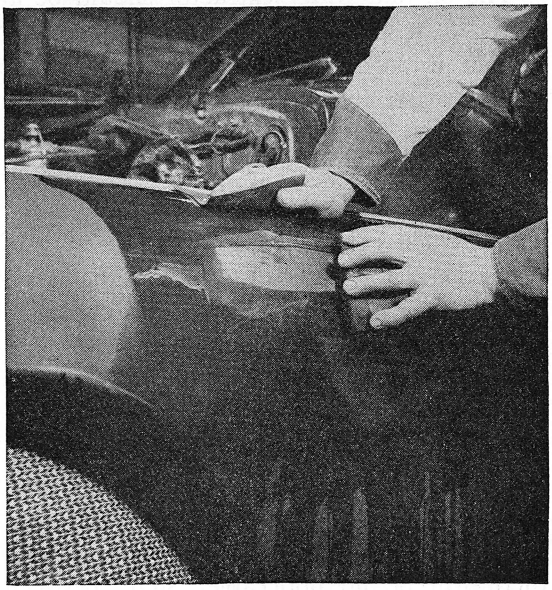

Fig. 8-23.

ing. Sanding done in this manner produces a more even surface. By turning the sanding block sidewise, it can also be used as a squeegee to remove water and residue from the surface being worked (Fig. 8-23).

Hand Sanding

Sandpaper should be folded as shown in Figs. 8-24 and 8-25. Folded in this manner, no two surfaces of grit contact each other,

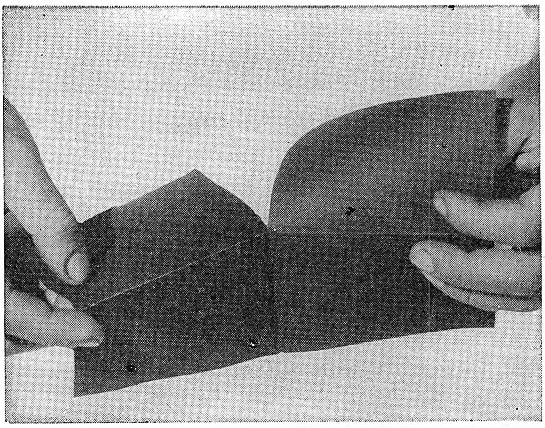

Fig. 8-24.

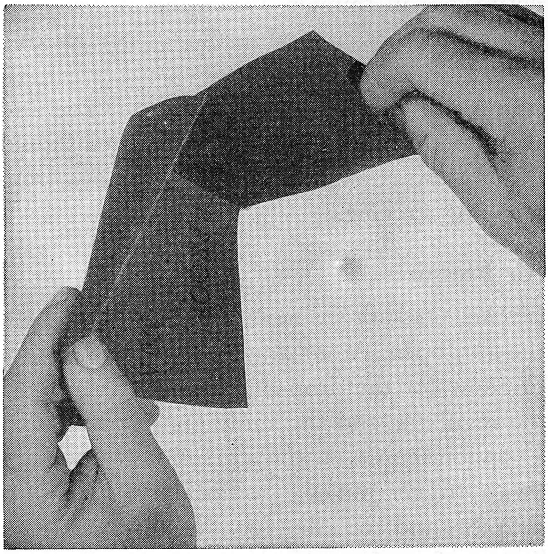

Fig. 8-25.

Fig. 8-26.

thereby wearing the grit away needlessly. When two surfaces are worn out, the paper can be refolded to expose the two unused surfaces for sanding. Only one-half of the sheet is used at a time. One corner of the pad is grasped between the thumb and index finger (Fig. 8-26). The fingers are placed diagonally across the pad while the sandpaper is moved in a straight line along the length of the pad. Do not sand with the finger tips except in places that cannot be reached in any other way.

Always sand lengthwise in straight lines. Sanding in circles will produce scratches that will show through the final finish. Light pressure should always be used, and care should be taken not to scratch chrome trim or glass.

Masking

All parts of the automobile not to be painted, such as windows, moldings, head-lamp doors, etc., are covered with tape and paper. This is called "masking." A specially made tape is used for holding the paper in place. Masking tape is made in various widths, ¾ in. being the width most commonly used in automobile refinishing. However, several widths should be stocked for the sake of economy.

When applying tape, the roll should be held as in Fig. 8-27, with a finger under the tape, and the tape should be torn off somewhat in front of the finger to leave a loose end for easy application of the next strip.

Masking paper is recommended in refinishing. It is made in several widths, has a smooth finish, and will not collect dust.

When masking head-lamp, doors, tail lamps, and two-tone jobs, the tape should be applied to the paper before masking to save time and material. A masked two-tone job is shown in Fig. 8-28.

In masking windows, the paper is cut ¼ in. smaller than the glass to allow space around the paper for applying the tape to both glass and paper. On windshields and

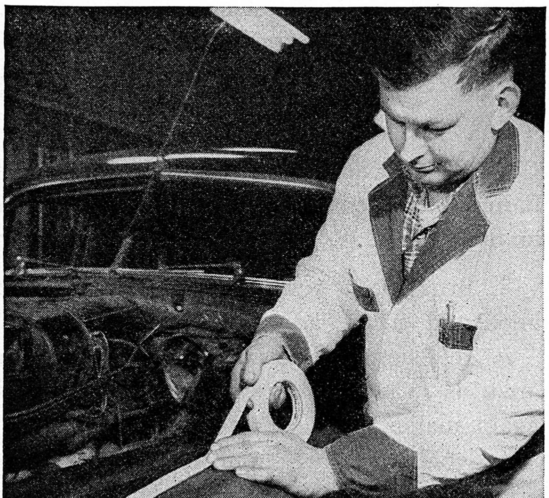

Fig. 8-27.

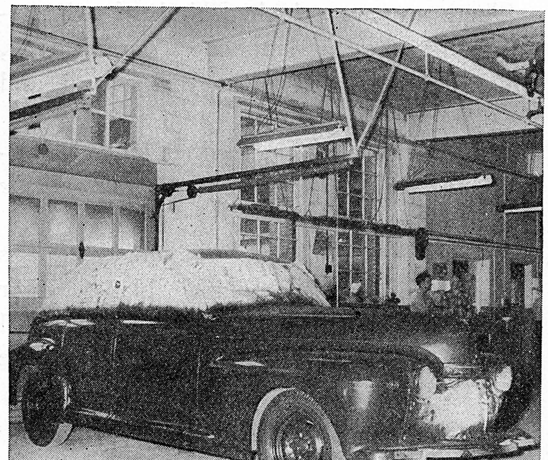

Fig. 8-28.

Fig. 8-29.

glass set in rubber, a strip of tape is first applied to the rubber; the paper is then cut and fastened with another strip of tape.

Apply masking tape lengthwise to door handles for easy removal. Always mask the windlace and upholstery when painting around door openings. It is easier to mask than to clean paint from upholstery.

When masking bodies for fender painting, a single strip of tape is sufficient for holding the paper. Small tucks are made in the masking paper to conform to the curvature of the fender, leaving the paper flat against the body (Fig. 8-29).

Be careful to mask completely the parts not to be painted, but do not extend tape beyond those parts, as on moldings.

Removing Paint

In a refinishing job, the old paint must be removed if it is *checked*. *Checked* paint has hairlines visible on its surface; and if these lines are present, the paint must be removed, because under the lines there is rust in the metal.

There are two principal kinds of paint remover on the market; one contains wax, which retards evaporation of the solvent, and the other contains no wax.

In using a remover of either kind, the *instructions printed on the container should be carefully followed.*

Before the work of removing paint is begun, the windshield-wiper blades, door handles, all chrome moldings, ornaments, and bumper face bars must be removed from the car.

Tools and Equipment

Screw drivers; ¼-in. socket wrench set; putty knife; a 3-in. paint brush; rubber gloves; wire brush.

Materials

Paint remover; steel wool; solvent cleaner; clean rags; No. 80 sandpaper; rust remover.

Procedure

1. Pour a small quantity of paint remover into an open container.

a. Be sure to close the original container to prevent evaporation of its contents.

CAUTION: Some paint removers are inflammable; these should be kept away from an open flame.

2. Brush paint remover on one side of the hood and on the adjacent front fender.

a. If remover is applied to too large an area, it evaporates and the paint hardens again, making it difficult to scrape.

b. Rubber gloves should be worn when applying paint remover and when scraping.

3. Scrape off the paint with a putty knife as soon as it is soft all the way through to the metal.

a. On some cars, the first coat of paint or surface has been baked on, and in such cases more than one application of paint remover is required for complete removal of the paint.

4. Rub the scraped area with steel wool until all traces of paint are gone.

a. Use a wire brush to remove the paint in drip moldings and around window rubber, etc.

5. Wipe the bare metal with solvent cleaner.

a. If the paint remover is wax-free, this step is not necessary.

6. Repeat operation 1 through 5 until the whole car is cleaned.

a. The order to be followed is: the other side of the hood and the other front fender and gravel shield; the top panel; the doors on one side; the doors on the other side; one rear-quarter panel and adjacent rear fender; the other rear-quarter panel and rear fender; the trunk door and gravel shield.

b. The paint on door jambs need not be removed.

7. Wash the entire car with solvent cleaner and wipe dry with a clean rag.

a. Solvent cleaner dissolves the wax. If the paint remover used is wax-free, the washing may be done with hot water instead of with a solvent cleaner.

b. Cleaning should be especially thorough around the door jambs where the paint was not removed.

c. If all cleaning is not done perfectly, wet spots will remain in the new paint, and these areas will eventually peel.

8. Sand all bare metal with No. 80 sandpaper.

a. Great care should be taken in sanding all edges, *e.g.,* around doors, trunk door, etc.

9. Wash the car with rust remover and wipe dry with a clean rag.

a. The cleaned metal should not be touched with the bare hand, as oil from the skin will adhere to it and make the paint peel.

The car is now ready for masking and priming.

Painting Lacquer over Bare Metal

Paint is applied with a spray gun powered by compressed air. Before beginning the actual work of painting, the workman must know what is the required consistency of the paint, how to adjust the gun, what air pressure to use, how far the gun should be held from the surface being painted, how thick each coat of paint should be, how many coats are to be applied, how long the paint should dry between coats, how to mix colors, how to hand-rub, and how to stripe.

The instructions printed on the paint container should be carefully followed.

The bare metal must be well sanded, free from rust, and perfectly clean, as described in the preceding chapter.

Tools and Equipment

Spray gun; sanding block; 10-qt. pail; sponge; squeegee; respirator; chamois skin; buffing machine; lamb's wool disk.

Materials

Lacquer paint; lacquer thinner; enamel thinner; paint strainer; primer-surfacer; glazing putty; masking tape; masking paper; No. 80 sandpaper; No. 320 sandpaper; No. 400 sandpaper; medium rubbing compound; clean rags; tack rag.

Procedure

1. Mask the car.
2. Spray on one coat of primer-surfacer.

a. Straight primer may be used instead of the primer-surfacer.

NOTE: Straight surfacer and glazing putty will not adhere permanently to bare metal.

3. Apply glazing putty (Fig. 8-30) to scratches and other slight imperfections in the metal.

NOTE: Any imperfections in the metal that require more than 1⁄16 in. of putty must be straightened.

4. Sand the putty with No. 80 sandpaper and sanding block.

a. A sanding block should always be used to sand putty.

5. Spray four coats of primer-surfacer.

a. To avoid cracking of the primer-surfacer, each coat should be dull before the next coat is applied.

b. The last coat should dry for at least 30 min. before sanding.

6. Wet-sand the entire job with No. 320 sandpaper, doing one section at a time.

a. The car should be kept clean throughout all stages of the work. As sanding residue accumulates, it should be washed off with a sponge and water, and the surface dried with a chamois skin.

b. If the surface is not free from scratches and pinholes, more primer-surfacer may have to be applied and then resanded.

7. Clean all cracks and crevices with compressed air or vacuum, if available.

8. Clean the entire surface with enamel thinner, and wipe dry with a clean rag.

a. The wiping must be done carefully, and the surface must not be touched with the bare hand.

9. Tack-wipe the entire job with a tack rag.

a. A "tack rag" is cheesecloth treated with a special varnish and is used to pick up dust and lint.

10. Reduce the lacquer paint to be used to the required consistency and strain it.

11. Spray six wet coats of lacquer paint, over the entire job.

a. Paint should be sprayed in long strokes with the gun held 6 to 8 in. from the surface and at right angles to it (Fig. 8-31). The strokes are made back and forth, and at the

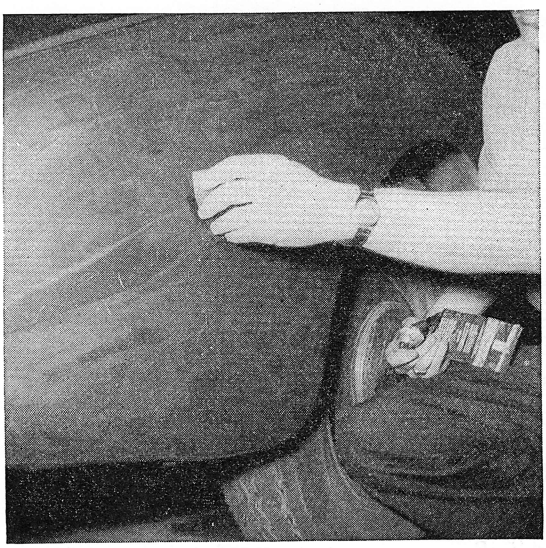

Fig. 8-30.

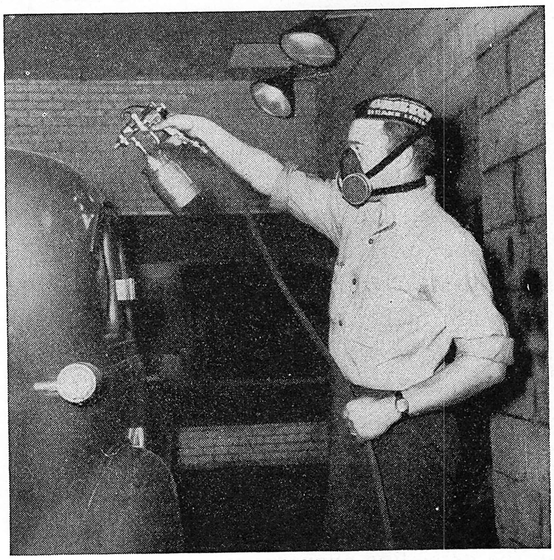

Fig. 8-31.

moment of reversing the stroke, the paint supply must be shut off by releasing the trigger. The trigger is pressed down again as soon as the gun is in motion on the next stroke. *Each stroke should overlap the preceding one by half its width.*

b. Paint one section at a time, *e.g.*, a door panel, one side of the hood, etc. The top panel can be painted in four sections.

c. When the first coat has become dull, the second coat is applied with strokes at right angles to the strokes of the first coat. This is repeated until the required number of coats has been applied.

d. Where a dust problem exists, the fifth coat is allowed to dry for 30 min. is sanded with No. 400 sandpaper to remove the nibs, then a sixth coat, which is a flow coat con-

FIG. 8-32.

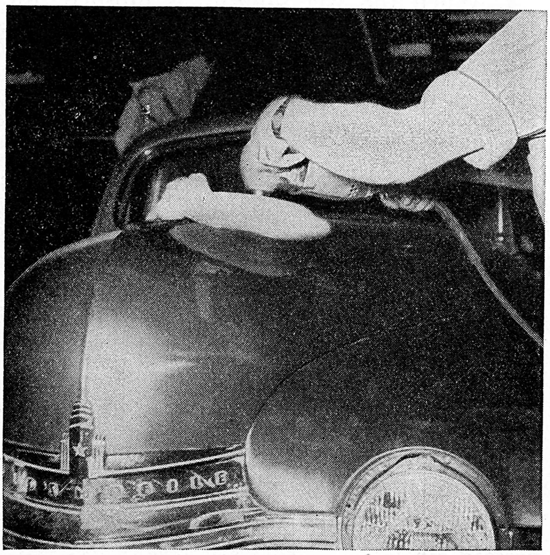

FIG. 8-33.

FIG. 8-34.

FIG. 8-35.

sisting of thinner and a very small amount of paint is applied.

12. Remove the wheels; wash thoroughly, wet-sand, and paint them.

13. Remove the masking from the car after the paint has dried for 12 hours.

14. Wet-sand the new paint lightly with No. 400 sandpaper.

a. The purpose of sanding is to remove the nibs.

15. Hand-rub the entire job with medium rubbing compound (Fig. 8-32).

a. Rubbing is done with a soft rag and a small amount of compound. It is the rubbing and not the quantity of compound which produces luster. Rubbing should be done lengthwise in long strokes.

16. Dry-buff with lamb's-wool disk (Fig. 8-33).

a. Dry buffing is done without compound.

17. Hand-rub the wheels and stripe them (Fig. 8-34).

18. Stripe the grille if necessary (Fig. 8-35).

19. Paint the tires with rubber paint.

NOTE: New paint should not be waxed for at least 30 days.

Painting Lacquer over Lacquer

Before preparing the surface for painting, it should be carefully examined to discover loose paint, rust under moldings, etc. Loose paint must be removed by scraping and sanding, and if there is rust under the moldings, they must be removed.

Tools and Equipment

Spray gun; sanding block; 10-qt. pail; sponge; squeegee; respirator: chamois skin; buffing machine; lamb's-wool disk.

Materials

Lacquer paint; lacquer thinner; enamel thinner; solvent cleaner; primer-surfacer; glazing putty; No. 280 sandpaper; No. 320 sandpaper; No. 400 sandpaper; No. 80 sandpaper; masking tape; masking paper; medium rubbing compound; paint strainer; clean rags; tack rag.

Procedure

1. Wash the entire car with solvent cleaner and wipe dry.

a. This removes all wax and grease.

2. Mask all chrome, glass, and parts not to be painted.

a. If the doorjambs and -posts need repainting, the windlace and upholstery panels should be masked.

3. Featheredge all nicks and scratches, using a sanding block, No. 280 sandpaper, and water.

a. The water is liberally applied with a sponge while the area is being sanded.

4. Wet-sand the entire old finish with No. 320 sandpaper, doing one section at a time.

a. When the wet sanding is finished, the surface should appear dull. Paint will not adhere to shiny spots.

5. Clean the entire surface with enamel thinner and wipe dry.

6. Apply rust remover to all bare metal, and wipe dry with a clean rag.

7. Clean all cracks and crevices with compressed air.

8. Spray primer-surfacer on all bare spots, building up the spot level with the surrounding surface.

a. This should dry for at least 30 min.

9. Wet-sand the primer-surfacer with No. 320 sandpaper and sanding block.

10. Clean cracks and crevices with compressed air.

11. Clean the entire surface with enamel thinner, and wipe dry with a clean rag.

a. The wiping must be done most carefully, and the surface must not be touched with the bare hand.

12. Tack-wipe the entire job.

13. Reduce the lacquer paint to be used to the required consistency and strain it.

14. Spray six wet coats of lacquer paint over the entire surface.

15. Remove the wheels; wash thoroughly, wet-sand, and paint them.

16. Remove the masking from the car after the paint has dried for 12 hours.

17. Wet-sand the new paint lightly with No. 400 sandpaper.

a. The purpose of this sanding is to remove nibs.

18. Hand-rub the entire job with medium rubbing compound.

19. Dry-buff with a lamb's-wool disk.

20. Hand-rub the wheels and stripe them.

21. Stripe the grille if necessary.

22. Paint the tires with rubber paint.

NOTE: New paint should not be waxed for at least 30 days.

Painting Lacquer over Baked Enamel

Baked enamel has a hard finish, so sanding must be very thorough to obtain good adhesion of the new paint.

Tools and Equipment

Spray gun; sanding block; 10-qt. pail; sponge; squeegee; respirator; chamois skin; buffing machine; lamb's-wool disk.

Materials

Lacquer paint; lacquer thinner; enamel thinner; solvent cleaner; primer-surfacer; sealer; glazing putty; No. 280 sandpaper; No. 320 sandpaper; No. 400 sandpaper; No. 80 sandpaper; masking tape; masking paper; medium rubbing compound; paint strainer; clean rags, tack rag.

Procedure

1. Wash the entire car with solvent cleaner and wipe dry.

a. This removes all wax and grease.

2. Mask all chrome, glass, and parts not to be painted.

a. If the doorjambs and -posts need repainting, the windlace and upholstery panels should be masked.

3. Featheredge all nicks and scratches, using a sanding block, No. 280 sandpaper, and water.

a. The water is liberally applied with a sponge while the area is being sanded.

4. Wet-sand the entire old finish with a No. 320 sandpaper, doing one section at a time.

a. When the wet-sanding is finished, the surface should appear dull. Paint will not adhere to shiny spots.

5. Clean the entire surface with enamel thinner and wipe dry.

6. Apply rust remover to all bare metal, and wipe dry with a clean rag.

7. Clean all cracks and crevices with compressed air.

8. Spray three wet coats of primer-surfacer over the entire job.

a. A sealer may be used to seal the primer-surfacer and prevent the new paint from dulling.

9. Wet-sand the entire surface with No. 320 sandpaper.

a. When sealer is used, light sanding with No. 320 sandpaper may be necessary to remove nibs.

10. Clean the whole job with enamel thinner.

11. Clean all cracks and crevices with compressed air.

12. Tack-wipe the entire job.

13. Thin and strain the paint to be used.

14. Spray six wet coats of lacquer paint over the entire surface.

15. Remove the wheels, wash thoroughly, wet-sand, and paint them.

16. Remove the masking from the car after the paint has dried for 12 hours.

17. Wet-sand the new paint lightly with No. 400 sandpaper.

a. The purpose of this sanding is to remove nibs.

18. Hand-rub the entire job with medium rubbing compound.

19. Dry-buff with a lamb's-wool disk.

20. Hand-rub the wheels and stripe them.

21. Stripe the grille if necessary.

22. Paint the tires with rubber paint.

NOTE: New paint should not be waxed for at least 30 days, or until after it has thoroughly hardened.

Painting Enamel over Lacquer

Enamel paint does not dry as fast as lacquer paint; so special care should be taken to prevent dust from settling on it while it is drying.

Tools and Equipment

Spray gun; sanding block; 10-qt. pail; sponge; squeegee; respirator; chamois skin.

Materials

Enamel paint; enamel thinner; lacquer thinner; primer-surfacer; sealer; solvent cleaner; paint strainer; glazing putty No. 280 sandpaper; No. 320 sandpaper; No. 80 sandpaper; masking tape; masking paper; clean rags; tack rag.

Procedure

1. Remove the wheels and clean them for painting.

2. Wash the entire car with solvent cleaner and wipe dry.

a. This removes all wax and grease.

3. Mask all chrome, glass, and parts not to be painted.

a. If the doorjambs and -posts need repainting, the windlace and upholstery panels should be masked.

4. Featheredge all nicks and scratches, using a sanding block, No. 280 sandpaper, and water.

a. The water is liberally applied with a sponge while the area is being sanded.

5. Wet-sand the entire old finish with No. 320 sandpaper, doing one section at a time.

a. When the wet sanding is finished, the surface should appear dull. Paint will not adhere to shiny spots.

6. Clean the entire surface with enamel thinner and wipe dry.

7. Apply rust remover to all bare metal, and wipe dry with a clean rag.

8. Clean all cracks and crevices with compressed air.

9. Spray primer-surfacer on all bare spots, building up the spot level with the surrounding surface.

a. This should dry for at least 30 min.

10. Wet-sand the primer-surfacer with No. 320 sandpaper and sanding block.

11. Clean cracks and crevices with compressed air.

12. Clean the entire surface with enamel thinner, and wipe dry with a clean rag.

a. The wiping must be done most carefully, and the surface must not be touched with the bare hand.

13. Dampen the floor.

a. This keeps down dust.

14. Reduce the enamel to be used to the required consistency, and strain it.

15. Tack-wipe the entire job, including the wheels.

16. Spray a medium-wet coat of enamel paint over the entire job.

a. A "medium-wet" coat is one which barely covers the surface.

b. The gun is operated with an air pressure of 60 lb. and is held 12 to 14 in. from the surface being painted, at right angles to it.

c. If there is a dust problem in the shop, a "double-header" coat will give good results. This makes a quicker job, and there is less time for dust to collect.

17. Spray on a *full coat* of enamel paint.

a. A "full coat" is heavier than a medium-wet coat and has a smooth, shiny surface without runs or sags. Spraying should be continued over a given area until the orange-peel surface begins to flow out.

18. Let dry for 24 hr., and remove masking.

19. Rinse the car with cold water to harden the enamel paint, and wipe dry immediately with a chamois skin.

20. Stripe where necessary.

Spot Painting

Spot painting on lacquer finishes can be done so skillfully that the newly painted spot cannot be distinguished from its surrounding area. Spot painting on baked enamel, however, is so difficult that painting of the entire panel or fender is recommended.

Tools and Equipment

Spray gun; sanding block; 10-qt. pail; sponge, squeegee, respirator; chamois skin.

Materials

Lacquer paint; lacquer thinner; primer-surfacer; solvent cleaner; paint strainer; glazing putty; rust remover; No. 80 sandpaper; No. 400 sandpaper; No. 320 sandpaper; enamel thinner; rubbing compound; masking tape; masking paper; clean rags; tack rag.

Procedure

1. Clean the spot to be painted and its surrounding area with a solvent cleaner.

2. Featheredge the old finish around the spot with dry No. 80 sandpaper and sanding block.

a. If the spot to be painted is a deep scratch, the paint must be sanded down to the metal.

3. Clean bare metal with rust remover and wipe dry.

4. Spray one coat of primer-surfacer extending not more than 1 in. beyond the spot to be painted.

5. Apply a thin coat of putty if the metal is rough, using a squeegee.

6. Let dry at least 30 min., and dry-sand with No. 80 sandpaper and sanding block.

7. Clean the surface to be painted with enamel thinner and wipe dry.

8. Spray the spot with a medium-wet coat of primer-surfacer, extending the paint over the featheredge.

a. Apply successive coats of primer-surfacer until the surface is level with the old paint.

b. Each coat of surfacer should be dull before the next coat is applied. This helps prevent the surfacer from cracking. The last coat should dry for at least 30 min. before sanding.

9. With No. 320 sandpaper and a sanding block, wet-sand the surfacer to within 1 in. of the edge of the spot.

a. The surfacer should be smooth and free from pinholes.

10. With medium rubbing compound hand-rub the area around the spot, including the 1 in. of unsanded surfacer.

a. Hand-rub until the old finish is glossy.

11. Clean the entire area with enamel thinner, and wipe dry with a clean rag.

12. Spray the spot with a medium-wet coat of lacquer paint.

13. Spray on four more coats of lacquer paint, extending each coat 1 in. beyond the preceding coat.

a. Each coat should dry until dull before the succeeding coat is applied.

14. Spray a light-wet coat of lacquer thinner over an area extending at least 6 in. beyond the new paint, and let dry for 3 hours.

a. This is done to blend the new paint with the old.

15. Hand-rub the entire area with medium rubbing compound.

Questions

1. How many types of sandpaper are in general use for sanding automotive finishes?
2. How should sanding be done? Why?
3. What procedure is used in masking bodies when fenders are to be repainted?
4. Before removing paint, what two steps should be taken?
5. When may hot water be used for washing a metal surface that is to be repainted?
6. How soon can a second coat of primer-surfacer be painted over the first coat?
7. How is lacquer paint applied when a dust problem exists?
8. How soon can a new paint job be waxed?
9. When is a sealer used? Why?
10. What air pressure is used when spraying enamel; lacquer?
11. What is meant by a "full coat"?
12. How many coats of primer-surfacer are applied to a spot that is to be repainted?

CHAPTER 9

Upholstery Replacement

Removing Upholstery

The following operations deal with upholstery that is to be reinstalled. It is therefore most important that the upholstery be removed carefully without tearing and soiling. One slip in removing tacks could cause a tear in the upholstery which could not be repaired without showing.

Headlining bows are of different lengths. It is wise to leave the bows in their respective listings. If they must be removed, make sure that they are replaced in the same listing from which they were removed.

When removing tacks, it is good practice to point the ripping tool away from the headlining so that if the ripping tool should slip, no damage would result.

Always be extremely careful when removing upholstery panels so that clips or nails will not be broken. The ripping tool must be held as close to the clips or nails as possible, to avoid breaking or tearing them from the upholstery panel.

To avoid damage and soiling, store the upholstery in a dry, clean place until it is ready for installation.

Tools and Equipment

Ripping tool; screw drivers; door-handle removing tool.

Materials

None.

Procedure

1. Remove the front seat and rear cushions.

2. Remove the windshield garnish moldings and rear-view mirror.

3. Remove the sun visors.

a. If there is a dome light, remove it.

4. Remove the rear-quarter window garnish moldings.

a. Some rear-quarter windows have no garnish moldings but are mounted in a heavy rubber frame. In this case, the window must be removed with the rubber frame. The same is true of the rear window.

5. Remove the rear shelf cover.

6. Remove the rear-window garnish molding or the window if necessary.

7. Loosen the headlining around the windshield.

Figure 9-1 shows and names the parts in upholstery where tacks are used.

Figure 9-2 shows and names the parts in upholstery where retaining strips are used.

8. Remove the wire-on gimp.

9. Loosen the headlining from front to back by starting at one front corner.

a. Where retaining strips are used, loosen headlining up to the first screw and remove the screw. Loosen to the next screw, and remove the screw, etc. (Fig. 9-2).

10. Loosen the headlining at the rear-quarter window.

a. Some headlinings are cemented, while others are tacked.

b. Be sure to save the padding around the rear-quarter windows. Padding must be used for installing the headlining to make the garnish moldings fit properly.

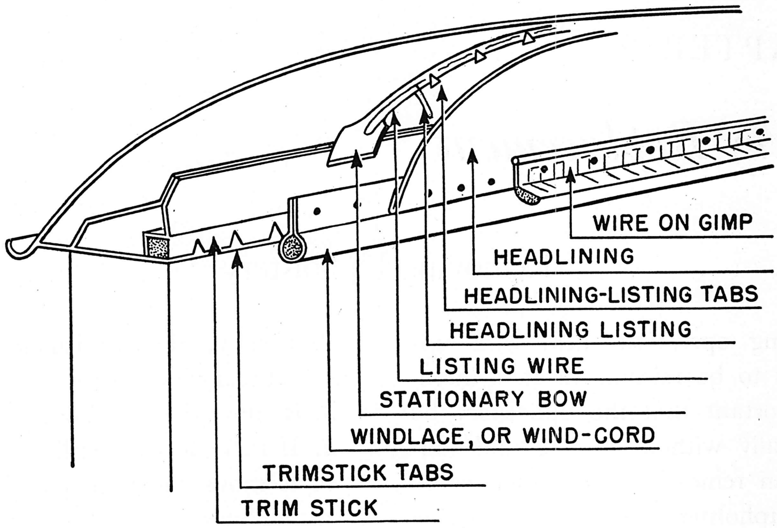

FIG. 9-1.

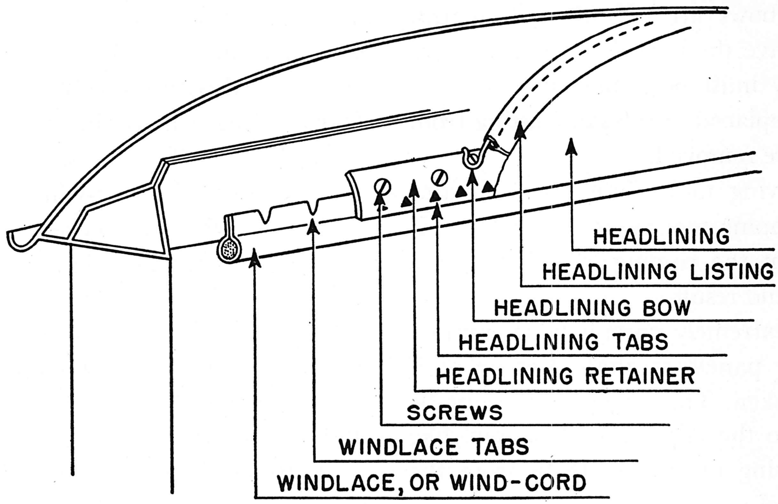

FIG. 9-2.

11. Loosen the headlining at the rear shelf by removing the tacks.

12. Loosen the headlining around the rear-window opening.

13. Remove headlining from the other side in the same manner, beginning at the front corner.

a. Some headlinings are fastened with screws.

14. Remove the bows, beginning at the front.

a. Where the bows are screwed to the roof rails, remove the screw at one end, and support the bow while removing the screw at the other end to avoid bending it.

15. Unhook spring bows from the stationary bows by bending the tabs back (Fig. 9-1).

16. Roll up the headlining, and store it in a dry, clean place, leaving the bows inside the listing.

17. Remove the window-regulator handles.

18. Start removal of the rear-quarter upholstery panel from the top (*A,* Fig. 9-3).

a. Notice the nails at *A,* Fig. 9-3.

b. Some cars have wire brads or a similar device for fastening.

c. Examine the panel to determine the type of fastener used.

19. Remove the sheet-metal screw from the bottom of the forward end of the panel (*B*, Fig. 9-3).

20. Remove the sheet-metal screw at the upper rear edge of the panel, if one is used (*C*, Fig. 9-3).

21. Panel can now be removed by pulling it slightly forward and up.

a. There is a clip at the back of the arm rest to fasten the upholstery panel to the inner rear-quarter panel.

b. On some cars the arm rest is fastened with a screw through the wheel housing from the outside.

22. Remove the inside door handles, regulator handles, and garnish molding from the doors.

a. Some have pins and others have retaining springs for fastening door handles (Fig. 9-4).

23. Remove the upholstery panel from the door.

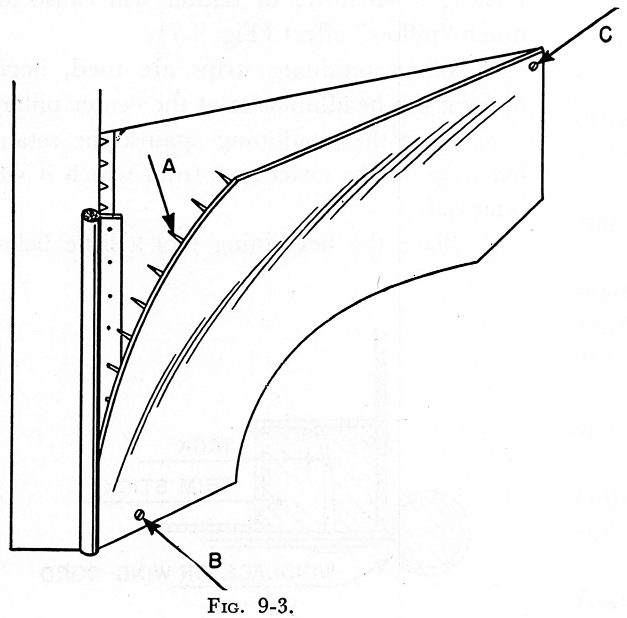

Fig. 9-3.

a. The panels are fastened with clips, nails, screws, or channels.

b. Examine closely before attempting removal, to determine the type of fastener being used.

24. Remove the center-pillar upholstery panel (*A*, Fig. 9-5).

a. These panels are fastened with wire brads, clips, screws, or have special long nails in the center of the panel. The nails are corrugated and enter a washer in the pillar. Be careful not to pull the nail through the upholstery panel.

25. Remove the windlace (*B*, Fig. 9-5).

a. Windlace is tacked or fastened with tabs.

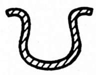

Fig. 9-4.

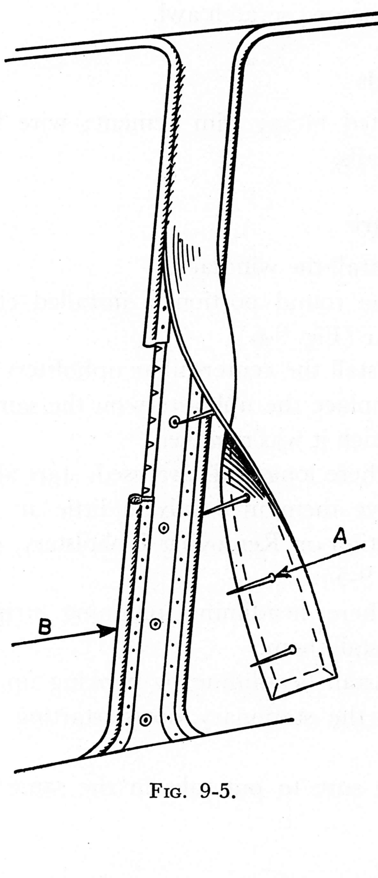

Fig. 9-5.

Installing Upholstery

The secret of reinstalling the old upholstery is to replace it on the exact spot from which it was removed. Changes in upholstery color are due to fading or the collection of dirt and dust. For instance, when the sun visors are not replaced on the exact spot from which they were removed, there are two shades of headlining. This not only indicates carelessness; it also indicate that the headlining probably does not fit at some point.

Upholstery must always be replaced so that it does not show that it was removed. The clips and channels form a guide for replacement of door panels, quarter panels, and center pillars.

Tools and Equipment

Screw drivers; upholstery-headlining tool; tack hammers; scratch awl.

Materials

Assorted tacks; trim cement; wire brads; repair nails.

Procedure

1. Install the windlace.

a. The round portion is installed close to the pillar (Fig. 9-6).

2. Install the center-pillar upholstery.

a. Replace the upholstery on the same side from which it was removed.

b. Where long nails are used, start all nails and drive them in evenly, a little at a time (see section on Removing Upholstery, p. 129 *A*, Fig. 9-5).

c. Where headlining retaining strips are used, install them.

3. Install headlining by hooking up listing wire to the stationary bows, starting at the back.

a. Be sure to put tabs in the same places on the listing of the headlining from which they were removed. Bend the tabs over the listing wire to keep it from coming off the tabs. Headlining will not be centered if this is not done.

4. Continue fastening the bows from back to front.

5. Stay-tack headlining to the rear shelf with three or four tacks.

a. "Stay-tacking" means driving tacks a short distance in, for easy removal during positioning of the headlining.

6. Use the scratch awl to locate screw holes for installation of the sun visors and dome light.

a. Install on the same spot from which they were removed so the difference between the faded and the original color of the headlining will not show.

7. Fasten the headlining at the center pillars.

a. Replace each side of the headlining on the exact spot from which it was removed. Putting it on lower or tighter will cause too much "pillow" effect (Fig. 9-7).

b. When retaining strips are used, begin tucking the headlining in at the center pillars.

c. Place the headlining against the retaining strip on the exact spot from which it was removed.

d. Place the headlining tool a little below

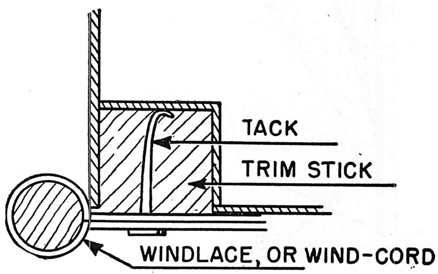

FIG. 9-6.

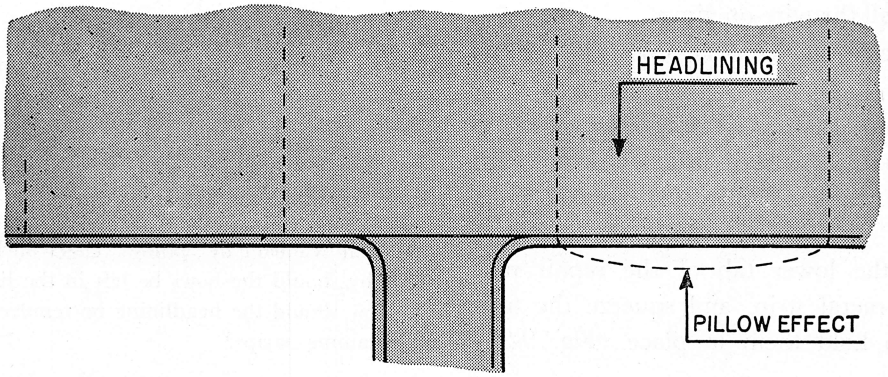

FIG. 9-7.

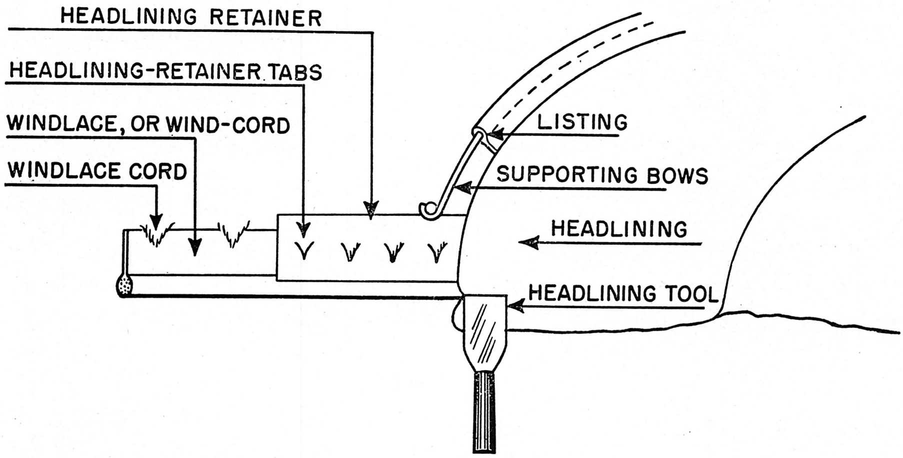

FIG. 9-8.

the retaining strip, and gently force material under the strip, being careful not to tear the headlining (Fig. 9-8).

8. Replace the other side of the headlining in the same manner.

9. Fasten headlining at the quarter panels.

a. Cement the padding in place if it has worked loose.

b. Coat the metal with cement, allowing it to become tacky before replacing the headlining.

10. Fasten the headlining around the rear window exactly as it was before removal.

11. Tack headlining to the shelf at the rear.

12. Fasten the headlining at the windshield.

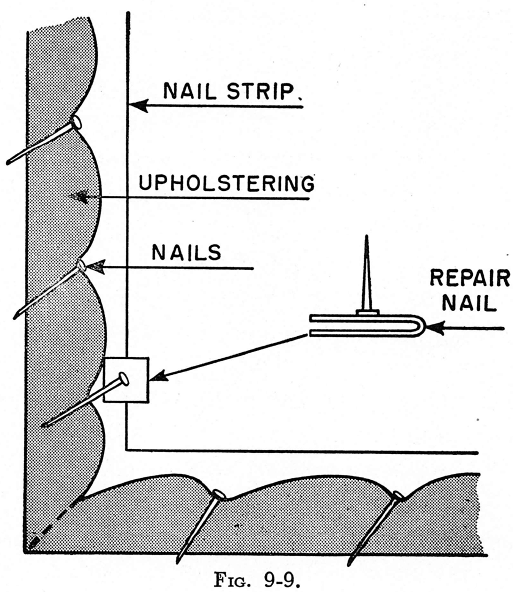

FIG. 9-9.

13. Install the wire-on gimp.

14. Reverse the removal procedure for replacing door upholstery panels and hardware (see section on Removing Upholstery, p. 129).

a. When the panel is fastened with nails, replace all broken nails with repair nails (Fig. 9-9).

b. Slip the lower tab of the repair nail under the metal strip, and squeeze the tabs together to hold them in place (Fig. 9-9).

Questions

1. What is most important in replacing upholstery?
2. Why must the headlining bows be replaced on the same spot from which they were removed?
3. What is meant by "stay-tacking"?
4. How is the headlining replaced on the retaining strips?
5. What is meant by "pillow" effect on headlining?
6. Why should the bows be left in the listings?
7. How should the headlining be removed from the retaining strips?

CHAPTER 10

Damage Estimating

Accuracy and thoroughness in estimating are promoted by following a definite plan in the inspection of each wreck brought into the shop. Only with experience and knowledge in each phase of body repairs can the estimator hope to provide an accurate appraisal. In appraising each wreck, the estimator should make careful note on each phase of the necessary work; then, upon completion of the job, he should check his estimate against the time actually needed for repairs and learn the reason for any mistakes that he has made so that they will not occur on following jobs.

Three major steps to successful estimating are as follows:

1. *Analysis of Damaging Impacts and Strains*

First observe the car and study the damage generally in an attempt to determine the nature of the objects against which the car collided as well as how and in what order the impact (s) occurred. This general knowledge of impact orders and directions aids in learning what assemblies were in the path of each impact and strain.

2. *Inspection of Damage by Unit Assemblies*

Inspect unit assemblies which were subjected to collision strains thoroughly. Proceed with inspection, taking but one unit assembly at a time and examining it thoroughly; then itemize needed repairs and replacements on the estimate or repair order *before* continuing to the next unit assembly. By doing the estimating in this manner, it becomes easier to trace damage through connected and functional related parts. Also, listing by units makes easier references when consulting parts or flat rate manuals.

Make it a practice to use a late-edition flat rate manual to secure various labor charges. These manuals have been made for shopmen and should be used.

Parts of each unit assembly are always inspected in the same definite sequence—for example, panels in the body shell. Sheet-metal unit assembly is inspected in the sequence of top, front, sides, back, and floor. Because the sequence is logical for each unit, it can be easily learned and readily followed. Speed is developed by inspecting a given assembly the same way every time. Following a set pattern becomes a familiar routine and prevents skipping over items of damage.

This chapter is confined to estimating of body repairs and will illustrate the inspection of body shell (less doors and trunk lid); body glass, trim and hardware (less doors); door and trunk lid assemblies, each being considered a separate unit.

The car shown in the following illustrations is an older model Pontiac that was especially marked with white paint to aid in illustrating the various points and types of damage. The sequence of steps in analyzing the extent of damage will not vary appreciably with the later model cars. The points to be learned are the methods of breaking down areas of damage, types of damage, and method of recording each step.

3. *Pricing the Estimate*

While inspecting the car and listing repairs and replacements, insert *no* parts prices or flat-rate labor on the estimate. Only estimated time allowances for repairs not covered in flat rate are inserted during inspection. Those labor allowances which must be established on the basis of the estimator's knowledge of the time required to perform certain repair operations can best be determined while he is looking at the damaged part and visualizing the repair procedure.

Insertion of parts and labor prices can best be deferred until the entire car has been inspected; then the repair order or estimate can be taken to a desk where parts and labor manuals can be consulted, thus assuring accurate pricing of the estimate. It is only after all repairs and replacements have been listed that a time can be determined for doing all flat-rate labor as one big combination operation.

It is well to point out at this point also that replacement parts should be judged in accordance with the age and value of the car. Often, with older cars in particular, it may be best to figure the price of a used door from an auto wrecker and repaint it rather than straighten the old door or replace it with a new one. Here, judgment of local conditions will dictate the course to follow.

Analysis of Damaging Impacts and Strains

In Fig. 10-1 scratches in paint and crushed parts reveal the direction and severity of each impact. This car has obviously turned over, and by *rolling caused sideward strain;* by *forward motion* caused *backward* strain; and by *falling* caused *downward* strain on the top.

From Fig. 10-2 we see that tracing the direction of forces through the connected parts from each direct impact locates indirect damage. Sideward strain buckled the center of the roof. Backward strain sent buckles toward the rear (resisted by strong reinforcements). Downward strain on the top buckled the quarter panel.

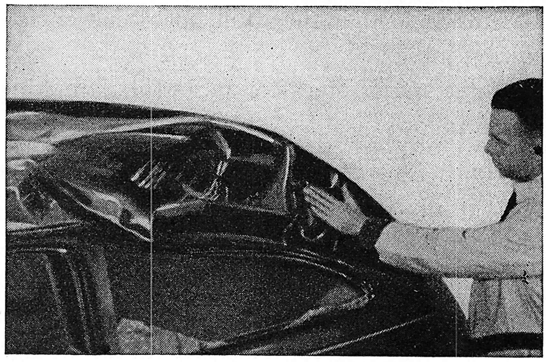

Fig. 10-1.

Inspection of Damage by Unit Assemblies

Body Sheet Metal

Two steps are taken in making this estimate. First, the body shell should be considered as a unit in establishing the time for aligning and roughing; second, each individual body panel should be separately considered in establishing time for bumping, metal finishing, and painting.

Figures 10-3 and 10-4 illustrate the reshaping of the distorted body assembly, particularly the reinforced sections, so that the body will be "square" in all three dimensions. Door and window openings must be reshaped so they will accommodate and permit proper operation of door and glass assemblies.

Figure 10-5 illustrates roughing work, consisting of reshaping distorted panels, particularly the outer panels, to their approximate

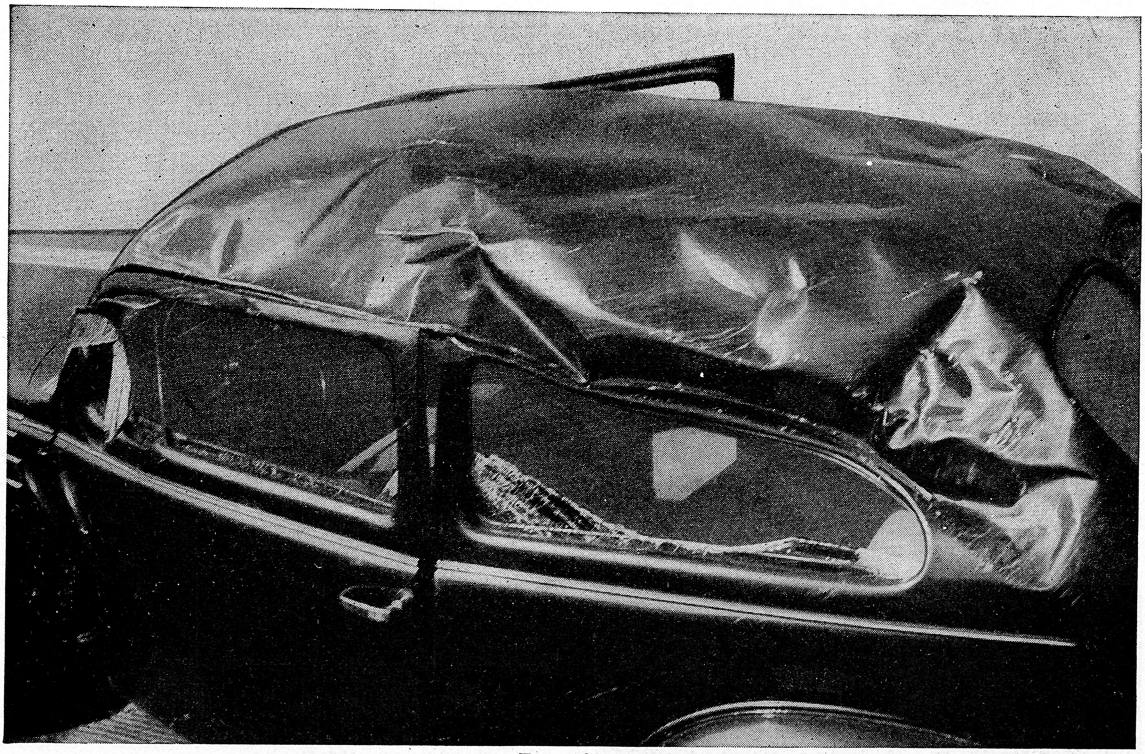

FIG. 10-2.

contour. Roughing alone is required where damage does not extend into the reinforced sections of the panel. The figure also illustrates aligning, a companion operation to roughing, in case reinforced and open sections of a panel must be reshaped in one operation.

Figure 10-6 shows that in manufacture the body shell is made by welding together

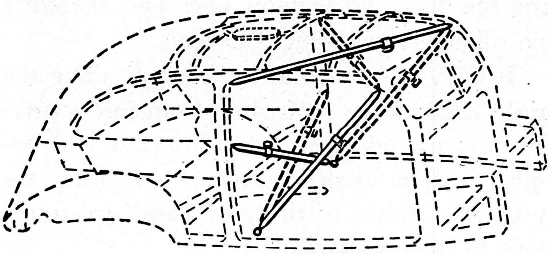

FIG. 10-3.

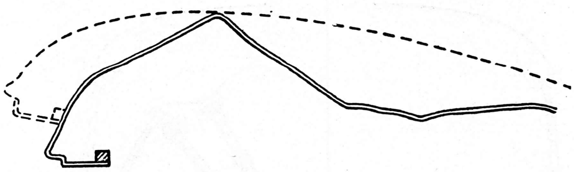

FIG. 10-5.

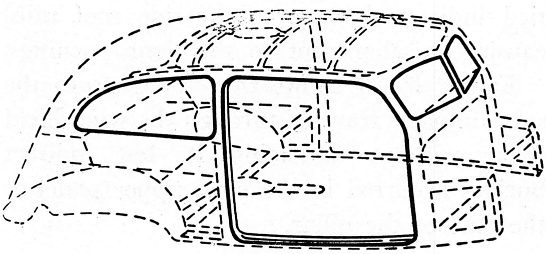

FIG. 10-4.

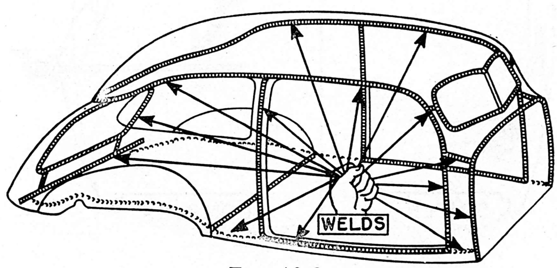

FIG. 10-6.

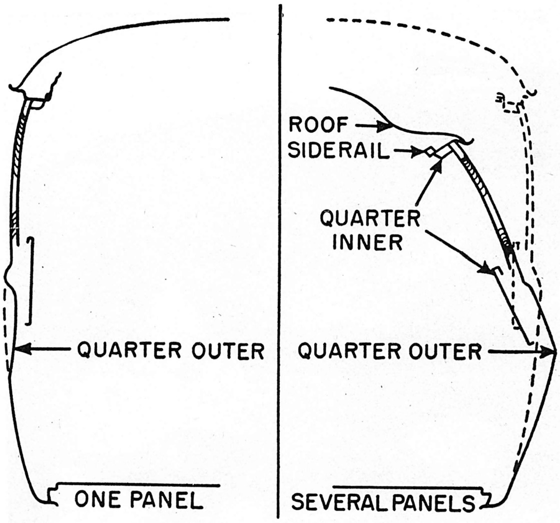

Fig. 10-7.

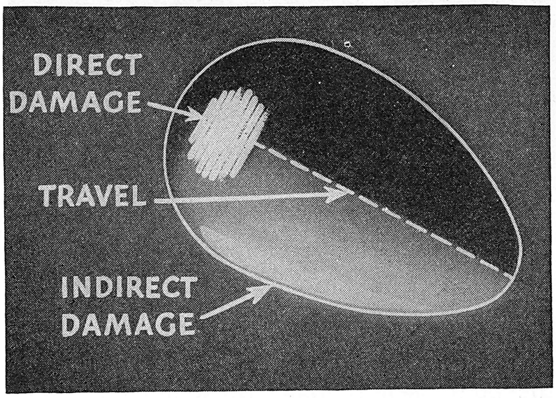

Fig. 10-8.

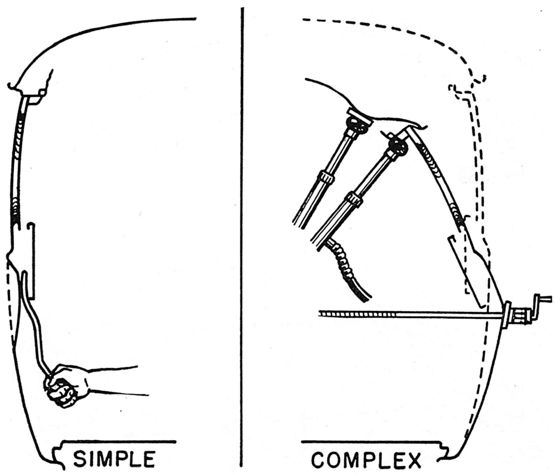

Fig. 10-9.

all of its panels into a single metal unit. A force which directly damages one panel may travel through that panel and welds connecting it to other parts and set up directs buckles and misalignments in other parts.

Figure 10-7 shows that the direct and indirect damage which results from one impact must be corrected in one aligning operation together with roughing, regardless of whether one or several panels are involved.

In Fig. 10-8 the time required to align and rough the body can be accurately established by visualizing the tool setup required to jointly remove all buckles formed by each direct impact.

In Fig. 10-9 the estimator, in applying the aligning and roughing principles to the car which is used as the subject of this chapter, will use a piece of chalk and illustrate areas of direct damage by shading, travel of damaging force by a broken line, and indirect damage by a solid line.

In Fig. 10-10 the direct damage to rear-quarter panel on the right caused a buckle in the outer panel which will require roughing. The force of the impact was not sufficient to distort the reinforcements surrounding the door and window openings; therefore no aligning operation is needed.

In Fig. 10-11 the direct impacts along the right edge of the roof came from forces driving down and back in a front to rear sequence. The indirect buckles radiating toward the center of the roof panel are traceable to these impacts.

Figure 10-12 shows downward forces carried indirect damage to the side roof rails, causing misalignment to the door openings.

Figure 10-13 shows that forces from the same impacts traveled through the windshield pillar without damaging it, but indirect buckles occurred in the cowl upper panel at the base of the pillar.

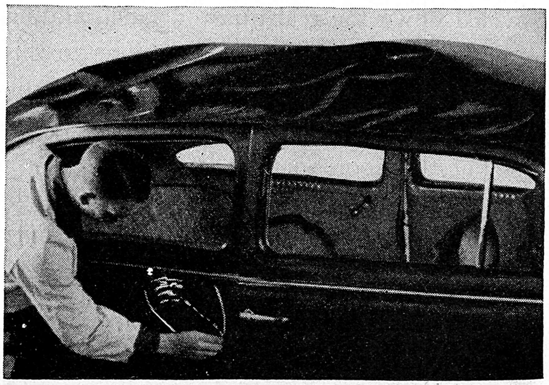

Fig. 10-10.

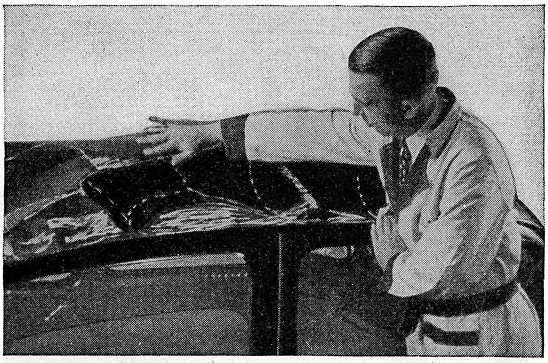

Fig. 10-11.

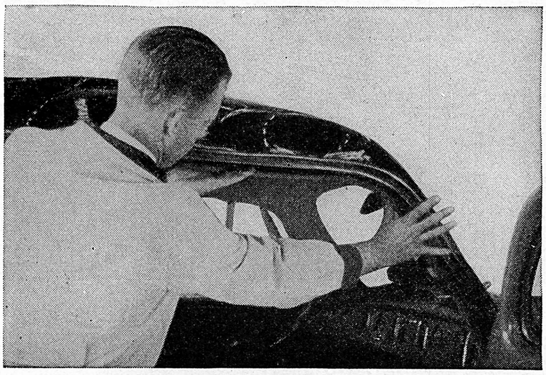

Fig. 10-12.

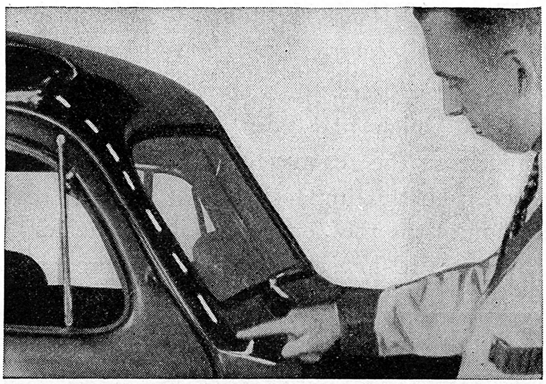

Fig. 10-13.

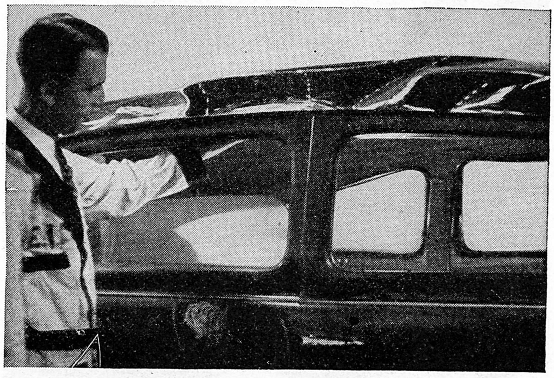

Fig. 10-14.

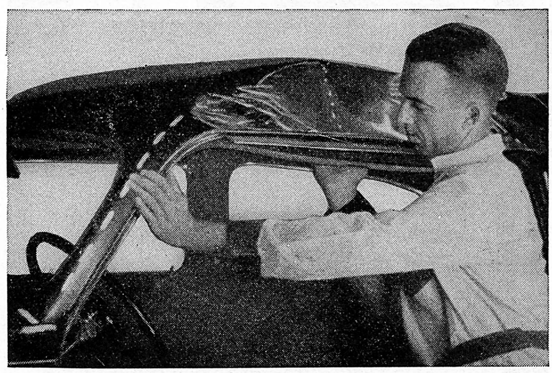

Fig. 10-15.

Figure 10-14 illustrates that a separate aligning and roughing operation will be needed to reshape all the damage resulting from the several impacts. Time for each operation will vary with the work involved, from simple roughing with a dolly block to using two jacks and roughing in the same operation. Aligning will proceed from rear to front, as impacts occurred in the reverse order.

Figure 10-15 shows frontal impact to left front section of roof struck down and back, causing indirect damage to the roof panel, door openings, and cowl upper panel below the windshield pillar. All this distortion must be reshaped and estimated as one aligning operation.

Figure 10-16 shows impact to the top, just forward of quarter pillar, resulting from downward forces. It occurred over indirect buckles which had been formed by earlier impacts to the rear section of the roof. The force from this impact traveled into the rear section of the roof, causing indirect buckles.

Figure 10-17 shows the same force also traveled down the rear-quarter panel, adding to the damage which had been done to this part by the earlier impacts to the rear of the roof. These forces also added to the misalignment of the door opening at the top.

Figure 10-18 illustrates that where damage from a later impact is superimposed over damage from a previous impact, time is al-

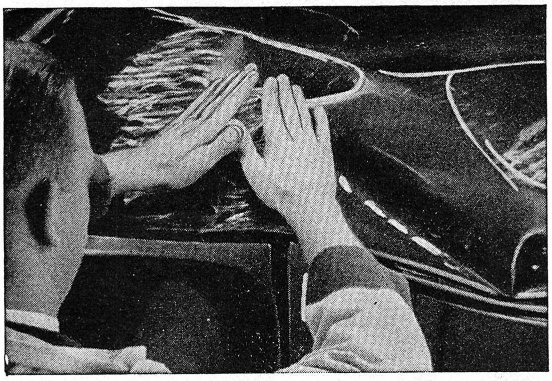

Fig. 10-16.

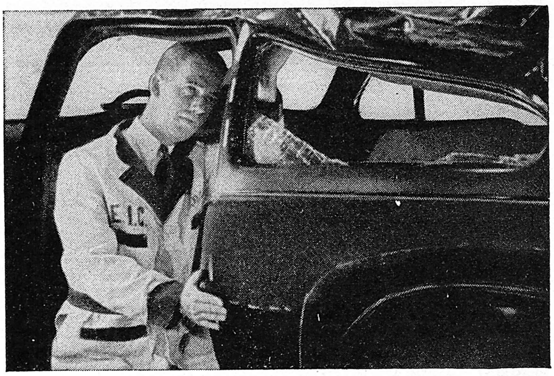

Fig. 10-17.

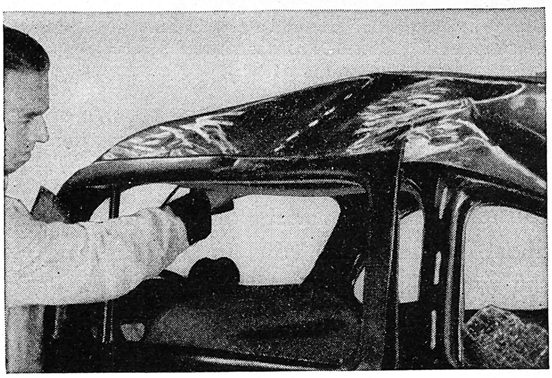

Fig. 10-18.

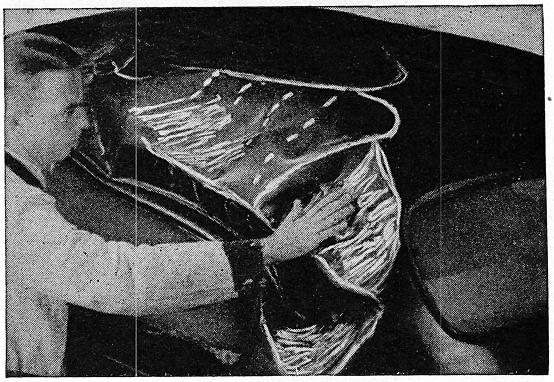

Fig. 10-19.

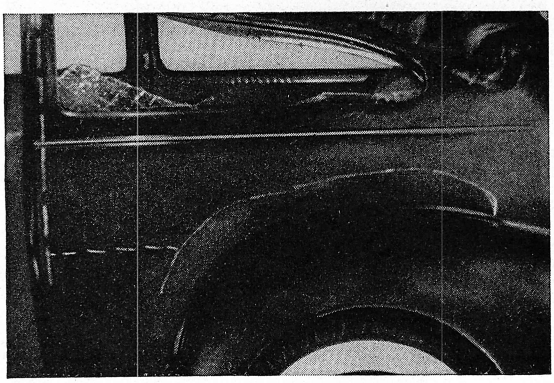

Fig. 10-20.

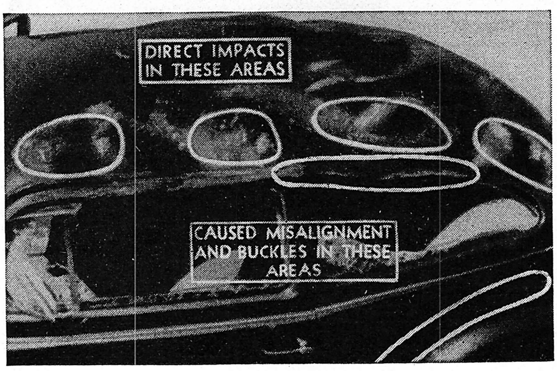

Fig. 10-21.

lowed only for aligning all the distortion caused by the *later* impact. The indirect buckles which had previously traveled into this area must be corrected jointly with the direct impact to the rear section which caused them.

Figure 10-19 shows direct impacts to the left rear section of the roof resulting from heavy inward and downward strain as the car landed on its top. Skidding then caused some backward strain. Indirect damage resulted to the upper section of the rear-quarter panels, inner and outer.

Figure 10-20 shows that the strains continued into the lower section of the rear-quarter panel and caused buckles at the dove-tail bumper and above the rear fender.

Figure 10-21 shows that the three related areas of direct impact in the left rear section occurred at approximately the same time and from the same forces. Damage, extending through the rear section of the roof and quarter panel, must all be brought out together in one operation.

Figure 10-22 illustrates that where damage in several panels is related, aligning time may all be charged to the panel which received the direct impact, or it may be proportioned between the panels that were directly or indirectly damaged by the impact.

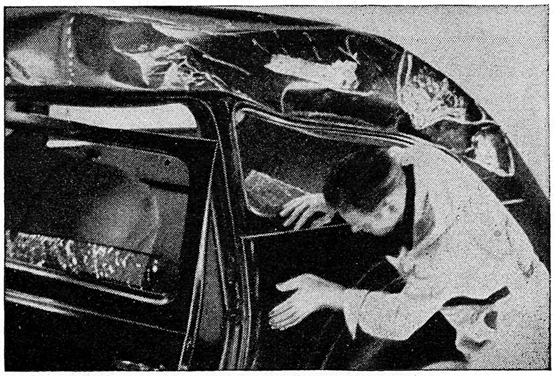

FIG. 10-22.

Bumping, Metal Finishing, and Painting

Time allowance for bumping, metal finishing, and painting is estimated separately for each panel, because these operations apply to individual panels rather than to the body shell in its entirety.

Estimates are needed separately on each panel to correctly determine whether the repair or the replacement of a panel is more economical. Estimate based on individual panels is also essential to the proper use of flat rate and parts manuals.

To correctly allot time for bumping and metal finishing, estimator must visualize how much correction will be given to each panel by the roughing and aligning operation. The amount of correction can be judged quite accurately by considering the amount of elastic and nonelastic metal in each buckle.

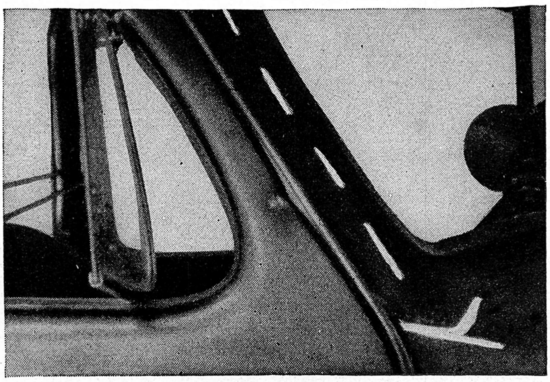

FIG. 10-23.

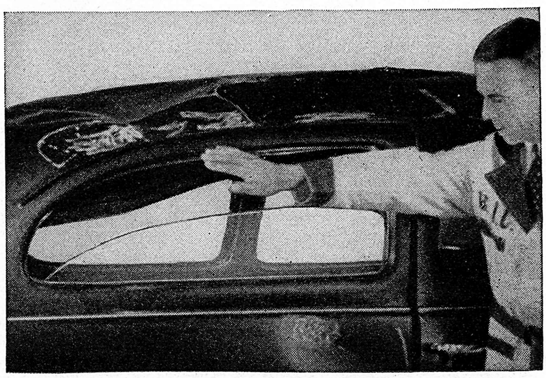

FIG. 10-24.

Figure 10-23 shows why buckles at the base of the windshield pillars will be depressed and solder-filled. It is more economical than removing underlying construction in order to use backing-up tool required for bumping. Refinishing of the cowl upper panel is estimated at flat rate to cover the damage below both pillars.

In Fig. 10-24 upper quarter panel will be completely refinished to remove all scratches. Flat rate is used for this estimate.

Figure 10-25 shows that after roughing and spring-hammering the lower quarter panel, a small dent will remain which can be pulled out, filled with solder, and refinished. The metal on this bulge is elastic and will reshape itself. Only spot refinishing will be necessary.

In Fig. 10-26 the estimator, visualizing the upper quarter panel as it will be after aligning and roughing, allows for bumping at the rear, considerable filling at the upper reveal, and refinishing.

Figure 10-27 shows that the lower quarter panel will only require bumping at the sharp ridge over the fender and filling around the dovetail where the inner panel prevents bumping. Flat rate for refinishing the quarter panel over the passenger compartment will be allowed.

Figure 10-28 shows how direct impacts just above the rain-drip molding on the right side of the roof occurred in metal which was sharply drawn from the forming dies and is relatively nonelastic. All metal in the directly damaged areas must be reshaped by bumping and metal finishing.

In Fig. 10-29 large indirect buckles which extend in toward the center of the roof are in elastic metal. Here time must be allowed

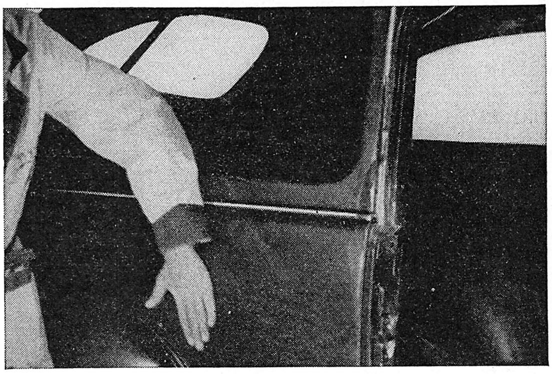

Fig. 10-25.

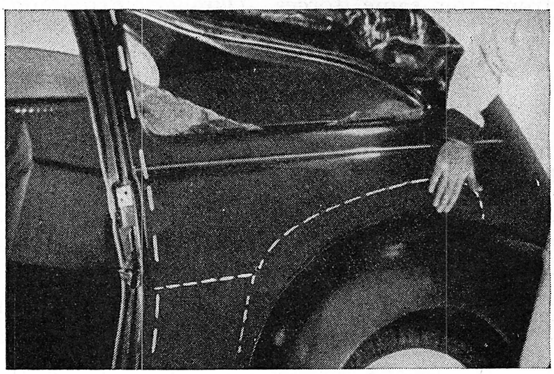

Fig. 10-27.

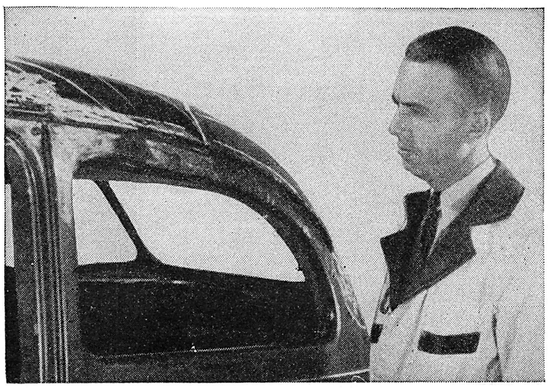

Fig. 10-26.

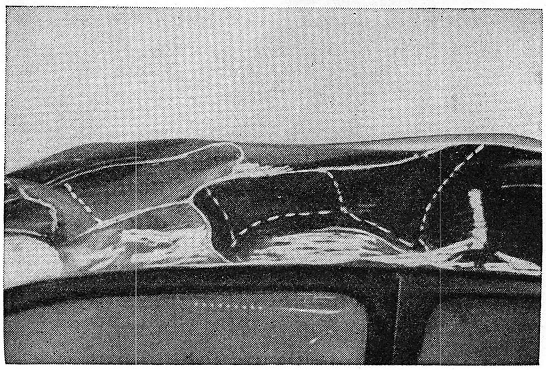

Fig. 10-28.

to fully bump and metal-finish the nonelastic ridges and valleys, with only a small time allowance required to reshape the large areas of elastic metal in the slopes of each buckle.

Figure 10-30 illustrates that the left-hand side of the roof has a greater concentration of short buckles and more nonelastic metal which must be reshaped.

Figure 10-31 shows that the highly crowned area at the rear of the roof was rendered nonelastic in manufacturing and was creased as well as buckled in the collision. Time allowance here must include bumping and metal finishing to reshape the entire area.

In Fig. 10-32 the small creases or gouges

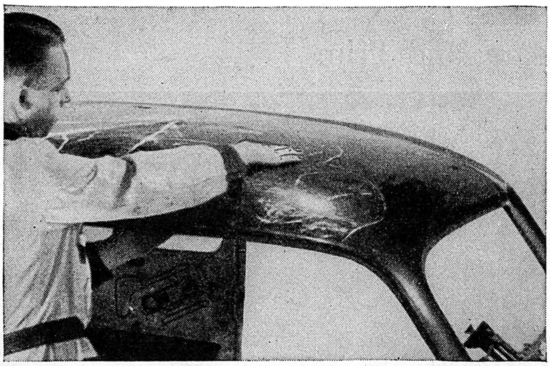

Fig. 10-29.

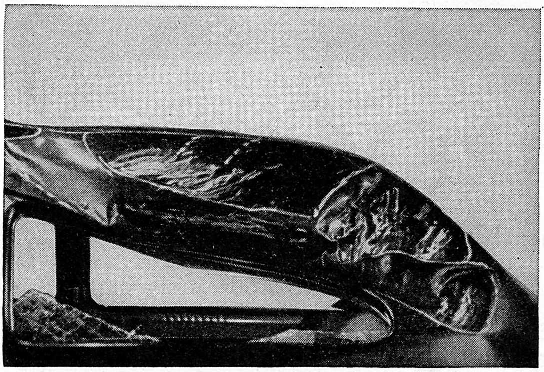

Fig. 10-30.

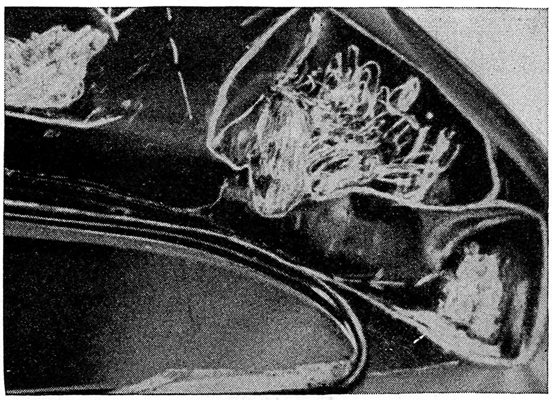

Fig. 10-31.

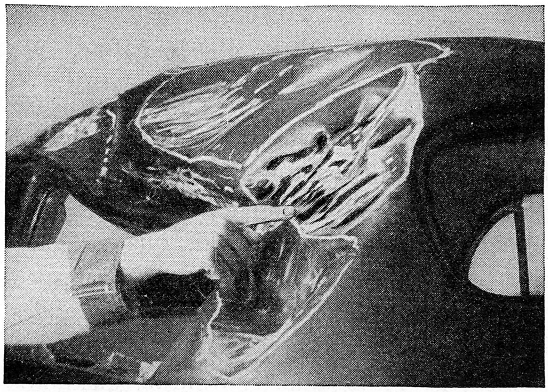

Fig. 10-32.

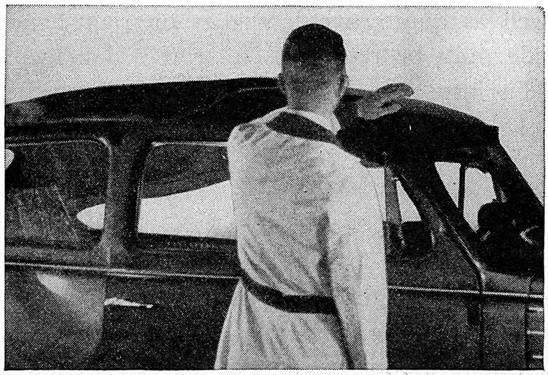

Fig. 10-33.

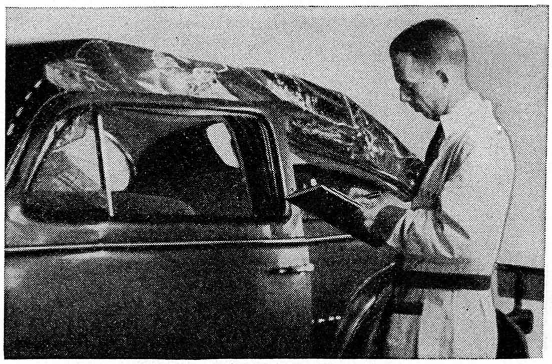

Fig. 10-34.

in this area indicate that the metal was stretched to some extent; therefore additional time must be allowed for heat shrinking.

In Fig. 10-33 the entire roof panel will require refinishing. Allow flat-rate time for this operation.

Figure 10-34 illustrates how, after completing the inspection, the estimator should fill out a repair order and list damage found, indicating:

1. Name of part.
2. Location of part *i.e.,* right, left, upper, or lower).
3. Description of repair needed.
4. Time allowance for repairs not covered in Flat Rate Manual.

Body Glass, Hardware, and Trim

Excepting doors, body glass, hardware, and trim are next inspected; and attention is given to the condition of such items as garnish molding, channels, and regulators also. Inspect the windshield, quarter glass, and back window in this order. Trim inspection follows sequence of top, front end, sides, back, floor, and seats.

In Fig. 10-35 quarter-window glass and garnish molding on the left-hand side as well as quarter-window glass on right-hand side must be replaced. No trim is damaged. This inspection is now complete and can be listed on the repair order.

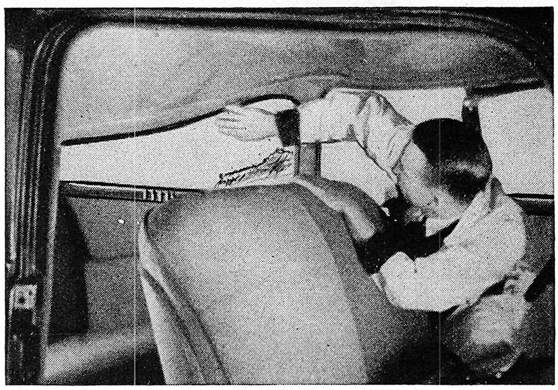

FIG. 10-35.

Door Assembly

In Fig. 10-36 left door requires aligning operation as the header was forced down, pulling in the lock and hinge pillars and buckling the lower panel at the belt molding.

In Fig. 10-37 the door inner-panel construction prevents bumping of the outer panel at the top of the door; therefore allowance will be based on refinishing with solder.

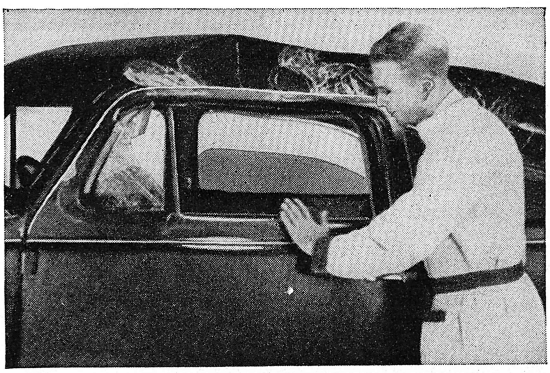

FIG. 10-36.

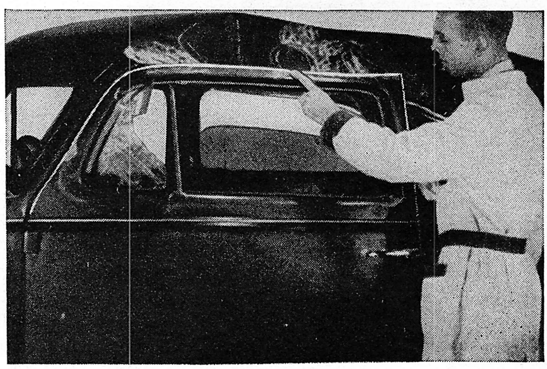

FIG. 10-37.

Necessary dismantling of the door will be allowed at flat rate.

Figure 10-38 illustrates that refinishing of the upper door panel will be allowed at flat rate, with a small additional allowance being made for spot-refinishing the lower section of the belt in conjunction with the complete refinishing of the upper section.

Figure 10-39 shows that door glass, hardware, and trim have now been inspected, after which all repairs and replacements needed for door assemblies are entered on the repair order.

Inspection of chassis would now follow the complete body inspection.

Figure 10-40 illustrates how after all body assemblies have been inspected, the repair order is taken to the desk where time and flat rate manual as well as parts manuals can be referred to, in filling in the necessary parts, labor time, and price.

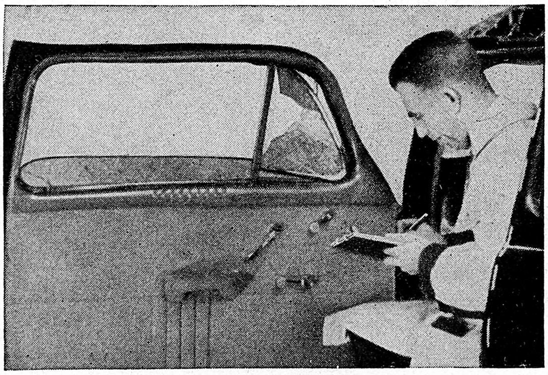

Fig. 10-39.

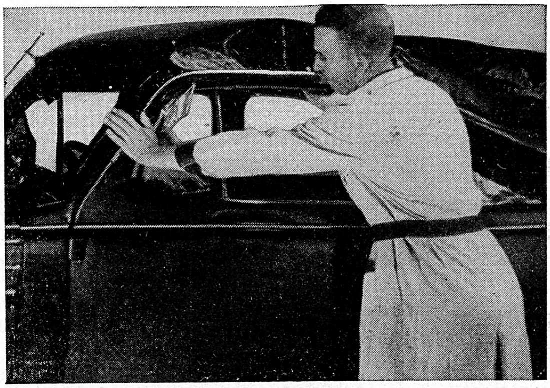

Fig. 10-38.

Fig. 10-40.

Flat-rate Body Labor

All jobs can be calculated from flat-rate labor data to enable the shop to price a repair operation properly. The following flat-rate data covering various body units are but a fraction of the operations performed, but they give the student some working knowledge of time allowed for the operations shown.

The data shown are taken from the pages of the 1951 edition of "Motor's Flat Rate Manual," 250 West 55th St., New York 19, N.Y.

The times shown are split into tenths of an hour so that multiplication by the shop hourly rate will be easier.

Buick

Car Complete, Refinish

Includes: Refinish body assembly, hood, radiator and grille panels, fenders, bumper aprons, chassis underside, and wheels. Does not include removal of paint or undercoating.

1942–48	27.9
1942–48 Conv.	23.4

1949 Ser. 40	27.9
1949 Ser. 40 Conv.	23.4
1949 Ser. 50, 70	
4 door	26.5
2 door	25.1
Conv.	20.6
1950–51 Models	
46, 46S, 56S, 76S,	24.6
41, 43, 48, 51, 71	26.0
52, 72	26.3
45C, 56C, 76C	20.5
45R, 56R, 72R, 75R, 76R,	23.1

FRONT FENDER

Front Fender and Radiator Assembly Renew and Refinish (As a Unit)

1942–51	4.7

Front Fender, Renew and Refinish

Does not include undercoating.

1942–48	5.6
1949 Ser. 40	5.6
1949 Ser. 50, 70	6.4
1950	5.3
1951 Ser. 40, 50	5.6
1951 Ser. 70	5.8

REAR FENDER

Rear Fender, Renew and Refinish

1942–49 Ser. 40, 60, 90	2.8
1942–49 Ser. 40, 60, 90	3.2
1942–48 Ser. 50, 70	
4 door	3.2
2 door	4.4
1949 Ser. 50, 70	
4 door	3.9
2 door	4.4
1950 All; 1951 Ser. 50, 70	
4 door	3.4
2 door	4.4

HOOD PANELS

Hood Top Panel, Renew and Refinish

Does not include undercoating.

1946–48	3.9
1949 Ser. 40	3.9
1949 Ser. 50, 70	3.0
1950–51	3.0

COWL AND DASH

Cowl and Dash Assembly, Renew and Refinish

1938–48	36.3
1949 Ser. 40	36.3
1949 Ser. 50, 70	
Closed	49.9
Conv.	38.5
1950–51	
Ser. 40 (Std.)	37.7
Ser. 40 (Deluxe)	39.4
Ser. 50, 70	39.4

WINDSHIELD

Windshield Glass, Renew

1941–48 All; 1949 Ser. 40	
One	0.9
Both	1.5
1949 Ser. 50, 70	
One	0.7
Both	1.1

FRONT DOOR

Add 0.6 to refinish fender extension on 4 door and 0.8 on 2 door and Conv.

Front-door Shell, Renew and Refinish

Includes: Transfer glass, trim and hardware.

1942–49 Ser. 40, 60 90	
Closed	7.8
Conv.	6.2
1942–48 Ser. 50, 70	
4 door	7.8
2 door	7.5
Conv.	6.2
1949 Ser. 50, 70	
Closed	6.2
Conv.	5.9
1950–51	7.5
1950–51	8.8

REAR DOOR

Renew and Refinish

Includes: Transfer glass, trim, and hardware.

1941–49 Ser. 40, 60, 90	5.0
1942–48 Ser. 50, 70	6.8
1949 Ser. 50, 70	6.5
1950–51 Models	
41, 51, 71	6.8
43, 52, 72	7.3
Ser. 50, 70	8.7

REAR-QUARTER PANEL (Complete)

1941–48 All; 1949 Ser. 40	
4 door	18.6
2 door	22.0
1949 Ser. 50, 70	
4 door	23.0
2 door	24.7
Riviera	28.0
Conv.	24.8
1950 All; 1951 Ser. 50, 70	
41 Std.	20.5
41 Deluxe	23.1
43 Std.	19.7
43 Deluxe	21.8
46, 46S Std.	24.2
46 Deluxe	26.3
51, 71	23.1
52, 72	28.0
56, 76S	26.3
Riviera	30.0
Conv.	26.0
1951 Ser. 40	
41, 41D	26.0
45R	30.0
46, 46S	28.2
46C	26.0
48, 48D	28.0

TURRET TOP

Renew and Refinish

Sedan	35.4
Coupe	30.9
1941–49 Ser. 40, 60, 90	
4 door	36.3
2 door	33.9
Coupe	30.0
1949 Ser. 50, 70	
4 door	44.9
2 door	38.1
1950–51	
41, 48, 51, 71	41.7
43 Std.	37.3
43 Deluxe	40.0
46, 46S Std.	32.8
46 Deluxe	34.3
56S, 76S	35.5
52, 72	43.0
Riviera	45.0

Chevrolet

Car Complete, Refinish

Includes: Refinish body assembly, hood, radiator, and grille panels, fenders, bumper aprons, chassis underside and wheels. Does not include removal of paint or undercoating.

1942–48	23.9
1949–51	
4 door	25.4
2 door	24.6
1942–48 Conv.	19.4
1949–51 Conv.	20.5

FRONT FENDER

Renew and Refinish

1942–48	3.9
1949–50	4.5
1951	5.0

REAR FENDER

Renew and Refinish

1940–48	2.4

HOOD

Renew and Refinish

1942–46—One side	3.3
Both sides	4.4
1947–51—One side	3.1
Both sides	4.0

COWL AND DASH

Renew and Refinish

Note: Transfer of accessories additional.

1942–48 Stylemaster	29.5
1942–48 Fleetmaster	30.7
1949–51 Special	35.7
1949–51 Deluxe	36.1
1949–51 Conv.	32.6

WINDSHIELD GLASS

Renew

1938–48—Both sides	1.5
1941–48—One side	0.9
1949–51 Special—One side	1.3
Both sides	2.4
1949–51 Deluxe—One side	1.4
Both sides	2.6

FRONT-DOOR SHELL

Renew and Refinish

1942–48 Stylemaster	6.2
1942–48 Fleetline and Fleetmaster	6.7
1942–48 Conv.	4.8
1949–51 Special	6.9
1949–51 Deluxe	7.6
1949–51 Conv.	6.0

REAR-DOOR SHELL

Renew and Refinish

1942–48 Stylemaster	4.7
1942–48 Fleetmaster	5.2
1938–48 Conv.	4.2
1949–51 Special	7.1
1949–51 Deluxe	7.6

REAR-QUARTER PANEL

Renew and Refinish

Note: On 1949–51 models, labor time is for left, deduct 0.2 hr. for right.

1941–48 Special and Stylemaster	
4 door	18.8
2 door and coupe	21.8
1941–48 Master and Fleetmaster	
4 door	18.1
2 door and coupe	21.2
1949–51 Styleline Special	
4 door	20.7
2 door	25.8
Sport coupe	25.3
1949–51 Styleline Deluxe	
4 door	21.1
2 door	26.6
Sport coupe	26.1
1949–51 Fleetline Special	
4 door	20.2
2 door	26.0
Sport coupe	26.1
1949–51	
Bus. coupe	24.4
Conv.	22.7

TURRET TOP

Renew and Refinish

1942–48 Stylemaster	
4 door	34.1
2 door	31.7
Coupe	27.8
1942–48 Fleetline and Fleetmaster	
4 door	36.3
2 door	33.9
Coupe	30.0
1949–51 Styleline Special	
4 door	38.6
2 door	33.9
1949–51 Styleline Deluxe	
4 door	39.2
2 door	35.3
1949–51 Fleetline Special	
4 door	39.2
2 door	35.3
1949–51 Fleetline Special	
4 door	38.3
2 door	33.6
1949–51 Fleetline Deluxe	
4 door	39.2
2 door	35.0
1949–51	
Special coupe	33.0
Deluxe coupe	34.3
Bus. coupe	32.9

Ford

Car Complete, Refinish

Includes: Refinish body assembly, hood, radiator and grille panels, fenders, bumper aprons, chassis underside, and wheels. Does not include removal of paint or undercoating.

1938–51	
4 door	25.0
2 door	24.0
Conv.	20.0

FRONT FENDER

Renew and Refinish

1942–48	5.0
1949–51	4.0

REAR FENDER

Renew and Refinish

Note: 1949–51 models include fender with rear-quarter panel.

1938–48	3.5

HOOD-TOP PANEL

Renew and Refinish

1938–48	3.5
1949–51	3.0

COWL AND DASH

Renew and Refinish

1940–48 Conv.	30.0
1949–51 Conv.	26.0

WINDSHIELD GLASS

Renew

1938–48—One side	1.8
Both sides	2.5
1949–51—One side	1.3
Both sides	2.2

FRONT-DOOR SHELL

Renew and Refinish

1939–51	4.5
1939–51 Conv.	3.5

REAR-QUARTER PANEL

Renew and Refinish

1939–51	20.0

TURRET TOP

Renew and Refinish

1938–51	
4 door	33.0
2 door	30.0
Station wagon	28.0

Plymouth

Car Complete, Refinish

Includes: Refinish body assembly, hood, radiator grille panels, fenders, bumper aprons, chassis underside, and wheels.

1938–51	
4 door	38.00
2 door	26.0
Coupe	25.0
Conv.	23.0

FRONT-FENDER

Renew and Refinish

1942–48	5.0
1949–50	4.4
1951	5.0

HOOD-TOP PANEL

Renew and Refinish

1949–50	3.7

COWL-SIDE PANEL

Renew and Refinish

1946–51	8.5

WINDSHIELD GLASS

Renew

1940–50—One side	1.5
Both sides	2.0
P22—One side	1.3
Both sides	2.5
P23 (Cambridge)—One side	1.3
Both sides	2.5
P23 (Cranbrook)—One side	1.5
Both sides	2.8
1940–50 Conv.	2.0
1951 Conv.	2.8

FRONT-DOOR SHELL

Renew and Refinish

Includes: Transferring trim and hardware.

1946–48	5.9
1946–48 Conv.	5.7
1949–51	4.8

REAR-DOOR SHELL

Renew and Refinish

Includes: Transfering trim and hardware.

1939–48	4.4
1949–51	4.8

REAR-QUARTER PANEL

Renew and Refinish

1946–51	
4 door	22.0
2 door and coupe	25.0
Conv.	19.0

TURRET TOP

Renew and Refinish

1938–51	
4 door	35.0
Coupe	30.0
2 door	32.0

Pontiac

Car Complete, Refinish

Includes: Refinish body assembly, hood, radiator and grille panels, fenders, bumper aprons, chassis underside, and wheels.

1941–48	
24, 26, 28, 29	24.6
1941–48	
25, 27	25.4
1949–51	
4 door	24.8
2 door	24.5
Bus. coupe	23.6
Sedan coupe	24.0
Conv. coupe	19.9
Catalina coupe	22.7

FRONT FENDER

Renew and Refinish

1938–48	4.7
1949	4.4
1950–51	3.6

REAR FENDER

Renew and Refinish

1949–51 models include fender with rear-quarter panel

1938–48	1.3

HOOD UPPER PANEL

Renew and Refinish

1941–48	
One side	4.8
Both sides	6.2
1949–51	
One side	4.4
Both sides	5.6

COWL AND DASH

Renew and Refinish

Includes: Remove and replace standard equipment parts attaching to cowl; transfer of accessories additional.

1941–48	32.3
1949–51	33.5
1949–51 Conv.	30.9
1950–51 Catalina	32.9

WINDSHIELD GLASS

Renew

1941–48	
One side	0.9
Both sides	1.5
1949–51	
One side	1.4
Both sides	2.6

FRONT-DOOR SHELL

Renew and Replace

1942–48	
25, 27	6.8
26, 28	6.6
Conv.	4.5
1949	
Std.	6.5
Deluxe	6.7
Conv.	5.7
1950–51	
Std.	7.2
Deluxe	7.4
Conv. and Catalina	6.4

REAR-DOOR SHELL

Renew and Refinish

1942–48	
25, 27	5.2
26, 28	5.0
1949–51	
Std.	6.9
Deluxe	7.2

REAR-QUARTER PANEL

Renew and Refinish

1941–48 Models 25, 27	
4 door	18.5
2 door and coupe	21.8
1941–48 Models 26, 28	
4 door	18.2
2 door and coupe	21.5
1949–51 (Left)	
4 door, Std.	22.7
4 door, Deluxe	23.1
2 door and coupe, Std.	27.5
2 door and coupe, Deluxe	28.2
Catalina and Conv.	25.1
1949–51 (Right)	
4 door, Std.	20.3
4 door, Deluxe	20.7
2 door and coupe, Std.	25.5
2 door and coupe, Deluxe	26.2
Catalina and Conv.	23.2

TURRET TOP

Renew and Refinish

1941–48 Models 25, 26, 27, and 28	
4 door	36.3
2 door	33.9
Coupe	30.0
1949–51 Streamliner	
Sedan coupe	34.9
4 door	39.3
1949–51 Chieftain	
4 door	39.3
2 door	34.9
Coupe and sedan coupe	34.0
Catalina	34.0

Questions

1. In what manner should the extent of the damage to a car be listed?
2. Is it necessary to use the "Flat Rate Manual" in making an estimate?
3. Should the method of damage estimating be varied from car to car? If so, why?
4. Should parts prices be listed as the car is inspected initially?
5. What time allowances should be listed on the initial inspection?
6. Does it matter whether the price of new or of used replacement parts is shown? If so, why?
7. Is there a difference between primary and secondary damages?
8. In what order should car glass be inspected?

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